COST-BENEFIT ANALYSIS FOR CRIME PREVENTION:
Opportunity Costs, Routine Savings and Crime Externalities[1]

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Abstract: *Research on cost-benefit analysis of situational crime prevention is examined and found wanting. The few existing studies do not accurately represent the likely benefits of the situational approach. While measures of non-monetary crime costs are improving, at least four other key areas warrant more attention: First, "routine savings" derive from routine precautions. Second, models of victim (producer) and offender (consumer) surplus are underdeveloped in this field. Third, crime externalities occur when entities (such as manufacturers, premises managers, some persons and environments) produce targets and situations that provide criminal opportunities. These entities "externalize" or do not bear the crime costs to society that they produce. We propose the concept of "crime as pollution" for the study of crime externalities, and outline the potential of policies adapted from environmental economics. Fourth, the intentional absence of crime prevention has an opportunity cost that might be examined as a form of negligent omission.*

I. INTRODUCTION

It is a truth universally acknowledged that a policy maker in possession of a large pending decision must be in want of a cost-benefit analysis. However little known the feelings or views of the policy maker, this truth is so well fixed in the minds of the surrounding advisors, that the decision is considered the rightful property of someone or other of their economists.[2]

There is a relative dearth of extant cost-benefit analyses of crime prevention. The most useful and comprehensive review is that of Welsh and Farrington (1999), who identify only 13 studies, and note that they are of widely varying quality. It is also the case that not all of the 13 studies included cost-benefit analyses: the 1999 article notes that they had to construct some of the cost-benefit analyses where the relevant information was available. Yet, despite this seemingly poor present state of affairs, this emerging cost-benefit literature is an implicit acknowledgement that crime prevention research is making progress. In fact, the argument can be made that cost-benefit analysis is a second-generation evaluation tool for crime prevention, since it moves beyond the questions 'Can crime be prevented?' and onto the more advanced questions Where and when is crime prevention most efficient?', or, rather, What factors allow crime prevention to maximize the net social benefit that it can produce?'. We argue here that expanding both the conceptualization and use of cost-benefit analysis is a critical next step in developing effective crime prevention policy and programming, and we offer some potential approaches to initiating these efforts.

It can be argued that, from a policy perspective, cost-benefit analysis has always been present in the study of crime prevention. Like it or not, cost-benefit analysis (hereafter CBA) is implicit to almost all crime prevention effort, in the same way it is implicit in most evaluation and assessment. When a prevention program is demonstrably shown to yield positive outcomes, it is normally assumed, at least in policy circles, that the overall benefit is greater than the overall cost, even when this is not empirically demonstrated. There are three main reasons why empirical CBAs are so few in number. First, crime prevention is an emerging area of research. Second, many programs, decision makers (and researchers) adhere to the notion that, where there are positive programmatic outcomes, logic dictates that the benefits truly outweigh the costs (and you just know it). Third, it is sometimes difficult and expensive, *in* relative terms, to do a comprehensive CBA of crime prevention that includes quantification of the whole range of costs and benefits (see Cohen, 2000; Greenwood et al., 1996; Miller et al., 1996; Gramlich, 1981). Fourth,

even the most sophisticated analyses of costs and benefits can often be picked apart as and when necessary by the critic, so that many programs are reticent about undergoing a CBA.

A general implication of this discussion is that either the standard of CBA as applied to crime prevention needs to improve, or else there needs to be a formal delineation of its potential and limits as it applies to this field. For the most part, the key problems relating to implementing quality cost-benefit analyses are not related to its theoretical appropriateness, but rather lie within its application. However, it is also proposed below that the cost-benefit analysis of crime prevention might benefit from expanding its focus. As with most emerging areas of study, there are a range of areas that remain to be explored. One aim of this essay is to begin to chart some of those areas.

In what follows, the role of cost-benefit analysis in evaluation in general, and its application to (situational) crime prevention in particular, are described. This is followed by a discussion of cost-benefit methodology, which, it is proposed, has been rather misunderstood in its current application. The subsequent section examines some of the more controversial aspects of measurement relating to cost-benefit analysis, and offers suggestions for progress. Finally, we suggest three areas for exploration using cost-benefit analysis. It is proposed that the opportunity cost of the absence of crime prevention should be assessed using CBA. It is also proposed that many crimes can be viewed as a form of "externality" or "pollution," or the unwanted byproduct that is caused by manufacturers making products that create criminal opportunities. Following these two analyses, it is proposed that there is a need for a policy alternative in response to manufacturing processes and designs that create criminal opportunities.

Assumptions of and Definitions for This Essay

Some familiarity of the reader with the crime prevention literature is assumed. More specifically, the first given is that situational crime prevention can work, and that crime can be prevented (see the previous volumes of the *Crime Prevention Studies* series, the *Security Journal,* or the series of over 100 studies produced by the Policing and Reducing Crime Unit of the U.K. Home Office). The second given is that not all prevented crime is displaced (see Eck, 1993; Hesseling, 1994). Often no prevented crime is displaced (committed at or by a different time, place, crime type, modus operandi, or offender), and when some is displaced it is typically less than 100%, so that a net social benefit generally still results. Further, crime displacement might be preferably viewed as crime deflection and used as a policy

tool to deliberately shape crime patterns so as to minimize their over-all social cost (Barr and Pease, 1990). The third given is that crime prevention can sometimes result in a diffusion of benefits. The term 'diffusion of crime prevention benefits' refers to the notion that effective crime prevention in one location can produce reductions in crime in neighboring areas or in relation to other types of crime (see Clarke and Weisburd [1994] for the definitive statement). Fourth, it is assumed that individuals who are, or own, potential targets, are risk-averse, and that risk-aversion does not vary with levels of crime. We refer to 'situationaT crime prevention (Clarke, 1980, 1995, 1998) as crime prevention.[3]

For simplicity, the key definitions relating to cost-benefit analysis that are stated by Dhiri and Brand (1999) are used throughout and are reproduced as Appendix 1. The one modification for present purposes is the acknowledgement that monetary units of measurement for cost-benefit analysis are merely a commonly accepted reference point for marginal utility units (i.e., welfare gain or loss). While many commentators are generally content that most costs and benefits can be converted to a consistent unit of analysis — i.e., can be monetized — some find this notion abhorrent, perhaps misunderstanding the rationale. The key aspects of the rationale are that utility units are the real issue, but that money is used as a more readily comprehendible proxy, and that while measurement is often imperfect, a far worse option is to exclude such cost items altogether. Social costs and benefits as referred to here can include both monetized and non-monetized components. Finally, since 'costs' and TDenefits' are the same thing viewed from the opposite side of the riverbank (costs are negative benefits, benefits are negative costs, and together they result in changes in net social welfare), they are sometimes referred to simply as costs. These issues are not discussed further.

II. WHY COST-BENEFIT ANALYSIS?

The analysis of the costs and benefits of crime prevention is necessary since, even though crime may be prevented (one of the 'givens,' above), it is certainly plausible that the cost of prevention could outweigh the benefits. In such a case, allowing the present situation to continue is a preferable policy solution, presumably while seeking a less costly form of crime prevention. Cost-effectiveness analysis — a variation of CBA to allow comparison of the outcomes of policy options with comparable costs — is also worth pursuing to allow for selection among a menu of prevention programs, given scarce public and private resources for all things.

Cost-benefit analysis as it has evolved in applied social research is a form of evaluation. In theory it is arguably the most sophisticated form of evaluation currently available. However, the absence of relevant information in many instances, the research expenses incurred in collecting the requisite data for small projects, traditional impediments to creating well-conceived comparison groups, as well as the sometimes disputed nature and definitions of the assumptions (and sometimes even the variables) involved, often distinguish the practice from the theory.

The main aim of CBA, like all forms of evaluation, is to provide information of utility to policy makers. The information might be used to assess and refine current policy, or to develop new policies. CBA can be focused on different levels, from the evaluation of philosophies and perspectives, to assessment of strategies, policies, tactics, specific activities, or the manner in which combinations of these are applied in specific circumstances. However, since crime prevention efforts typically need to be tailored to specific crime types and contexts, the theoretical spectrum of applications of crime prevention, and hence of the CBAs required, could be infinite. Hence for the purposes of informing crime control policy, evaluation via cost-benefit analysis might usefully inform broad areas of knowledge. This may be related to the fact that cost-benefit analysis developed as an economic instrument for the assessment of macro-level social policies, whereas its application in relation to crime prevention has been primarily at the micro- or project level. However, unlike many interventions typically studied using a CBA framework, crime prevention has clear macro- and micro-policy effects. Therefore, CBA seems especially well suited for its study.

Implicit Cost-Benefit Analysis

Individuals and society have already made many implicit cost-benefit decisions and continue to do so on an ongoing basis. Some people may choose to spend money on vacation rather than invest in a burglar alarm. Governments may have chosen to invest in education, health, education and crime control instead of transportation infrastructure. In each case, the decision between competing priorities is one of resource allocation: money is allocated to each up to the point where the perceived marginal costs and benefits are equal, i.e., where an extra dollar spent on more of it — the marginal cost — would give less extra or marginal benefit than spending the dollar on an alternative option, within their given resource constraints. In their implicit cost-benefit calculations, governments incorporate the estimated costs of going against the will of the public and various pres-

sure groups, which may reflect imperfect knowledge or beliefs about crime. Governments at all levels make similar decisions in resource allocation between competing social policy priorities, including crime prevention.

It is clear that many informal, implicit, and possibly ill-informed cost-benefit analyses take place on an ongoing basis, influencing decisions varying from those of the individual to those of social policy. Each decision relates in some way, often indirectly, to spending on crime prevention. As such, each decision can be viewed as embodying a cost-benefit analysis of crime prevention in all its varieties. An aim of formal cost-benefit analysis in the field of crime prevention, therefore, might be to reduce the inaccuracy of current implicit cost-benefit decisions. Reducing inaccuracy may be a more modest and realistic goal, perhaps preferable to a holy grail of CBA informed by perfect information. Such a shift in emphasis is potentially important, however, for crime prevention research and how it relates to policy. It suggests that easily-obtained broad-brush cost-benefit parameters, with reasonable confidence intervals, may be a more realistic and more useful aim than one of conducting a perfect cost-benefit analysis that accounts for all of the minutiae. For crime policy purposes, "rough 'n ready" may be preferable to "perfect but never completed," since a benchmark with known limitations is better than none.

Break-even Analysis

Ekblom and Pease (1995), among others, suggest that evaluators should, prior to implementation of an intervention, identify the mechanisms by which a crime prevention intervention is expected to work. That is to say, it is not enough to know that a program produces a desirable outcome: Evaluators should endeavor to determine *a priori* why it is expected to work. An analogous suggestion could be made in relation to cost-benefit analysis. It should be possible for evaluators to produce broad parameter estimates of a break-even point for interventions, prior to implementation. For example, assuming some knowledge of the costs of the crime (from previous studies), and some estimate of the fixed and variable costs of the intervention, it would be possible to produce an estimate of the reduction in crime that would be required to reach a break-even point. It could then be determined whether the required prevention level is realistic. Examples using limiting cases will clarify the issue and its potential utility: If a crime is minor and the proposed intervention is expensive, it might require a 95% reduction in crime to break even. Absent a particularly strong preventive mechanism, that required

prevention level is unlikely to be attained. However, if the crime being targeted is very costly to society, and the intervention is very cheap, then a 2% reduction in crime might be the break-even point. A proposed project is risky if it has a high break-even point and uses an untried prevention measure in a context where the preventive mechanism is uncertain. A proposed project is far less risky if it has a low break-even point where only a small percentage drop in crime required to produce a net gain. This latter scenario might be the case where, for example, a project replicates the application of a successful intervention, but puts it in a different context that is also thought to be conducive to a sound preventive mechanism being triggered.

Towards Standard Cost Estimates

The pioneering work of Miller et al. (1996) produced estimates of the tangible and intangible costs of crime for a range of crime types. Though their estimation method of victim-compensation has been questioned (and is discussed later,) it is nevertheless a landmark in the study of the costs of crime. The Miller et al. estimates were brilliantly adapted by Painter and Farrington (1999) in their cost-benefit analysis of improved street lighting. Painter and Farrington applied the Miller et al. estimates of the costs of crime to their own crime prevention scenario. In fact, Painter and Farrington may light the way towards methodological standardization of cost-benefit analysis for crime prevention. Assuming that estimates such as those of Miller are continually updated (and that any critics of the methodology can present improved or competing estimates rather than simply throwing mud), the field of cost-benefit analysis of crime prevention should improve markedly and be able to achieve some degree of methodological standardization. Such an element of standardization could result since, even if local project cost estimates vary widely from national estimates (Miller et al., [1996] use the U.S. National Crime Victimization Survey), they could be compared via the common metric of the standardized national estimates. Spatial variation in cost estimates will simply produce different lenses through which interventions can be compared. Local, regional, national or international mean estimates of the costs of crime are all simply different means or standards that allow different levels and types of comparability.

The following section examines the underlying economic model for measuring the costs and benefits of crime prevention. The section after that uses this model to inform cost-benefit models of crime prevention that look at prevention outcomes that typically have not been explained by conventional CBA applications.

III. DEVELOPING A COST-BENEFIT MODEL

This section examines the key components of the CBA model. The fundamental of this approach to evaluation might be thus summarized: Analysis of marginal costs and benefits, appropriately discounting for future events, can inform researchers and policy makers about changes in 'net social welfare' resulting from crime prevention initiatives.

Traditional Types of CBA

CBA was developed as a straightforward application of standard macroeconomic techniques in cases where a third-party intervened in the free market, leading to changes in consumer and/or producer behavior (Gramlich, 1991, 1998). Three types of intervention dominate the cost-benefit literature:

(1) *Product viability:* The first 'traditional' application of CBA is to determine whether a product is viable in the market. An example would be a judgment, an evaluation, relating to the production of a new drug. The CBA would compare the expected efficacy to the potential lethality, subject to information constraints, since both effectiveness and lethality of a new drug are unknown. This is the category into which most crime prevention research to date would fit — determining whether the crime prevention benefits of an intervention outweigh the costs. The programmatic cost-benefit evaluations, such as those conducted within the Safer Cities programmes (Ekblom et al., 1996) and the ongoing ambitious cost-benefit and cost-effectiveness assessments which will be produced within the U.K.'s Crime Reduction Programme (see Dhiri and Brand, 1999; Legg and Powell, 2000), would fit within this category, as akin to an evaluation of a portfolio of products. However, it is also the case that this category of cost-benefit analysis has far broader applications in the crime prevention sphere. For example, CBA would be applicable to the testing of new consumer products in determining the extent to which they might encourage or facilitate crime. The crime 'Foresight' program being developed in the U.K. (U.K. Department of Trade and Industry, 2000) is currently tackling such issues. The program may find that proposing a CBA approach will accelerate the implementation and broader adoption of the assessment of the criminogenic potential of new consumer products.

(2) *Government intervention in a monopoly market:* The most common example of CBA evaluations are those of a govern-

mental intervention in a monopoly market. The intervention typically takes the form of a tax or regulation, when it is assumed that social welfare is less than would be the case were there multiple suppliers. Such could be the case for an electricity monopoly where prices and output levels may be tightly regulated. This is arguably the relevant category for the analysis of aspects of government intervention to tackle the absence of crime prevention in many situations of market failure that, inadvertently or otherwise, promote crime (if absence can be viewed as a monopoly that needs breaking). Other crime-related examples would be the debates relating to the overall social cost or benefit of introducing privatization and competition to policing and prisons.

(3) *Taxation:* The third traditional application of CBA relates to the application of a tax. The basic question to be answered is 'Does a tax produce a net social benefit?' Increased social welfare is the aim of taxation: the question is, do societal benefits outweigh the costs, where such notions as freedom, justice and equity are included in the cost-benefit calculus, in addition to resource transfers. The correct level of general taxation, such as that on income is, of course, hotly contended, but the principle remains the same. Typically, cost-benefit analysis is applied to a situation where it is found, for example, that use of a product creates negative externalities. An example would be where, in relation to emissions from automobiles, the government imposes a tax to both change consumer and producer behavior. The tax reduces driving by consumers because of the higher cost, while the extra funds provided *could* be used to reimburse those harmed by emissions. In other instances, a fine or other punishment could also be imposed upon producers, such as manufacturers causing pollution. The punishment would encourage manufacturers to reduce the externalities, that is, to cut pollution, or to compensate society for the pollution costs imposed. Paul Ekblom suggested that "where crime problems are 'externalized' (i.e., where those who create the opportunity are not those who suffer the consequential crime) sanctions could be introduced to encourage closing the loophole" (Ekblom, 1998:29).

This third main category of CBA can be applied to crime policy in various ways. Fines and imprisonment are a tax imposed upon offenders for the cost they impose by their offending, and part of the aim is to change consumer behavior (to deter offenders). Victim com-

pensation has a precise parallel with the funds used to compensate those harmed by emissions into the environment (crimes). Perhaps most importantly for crime prevention, however, is the possibility that CBA might be used to encourage reductions in criminogenic products and environments. For many years, car makers produced cars without necessarily building in the socially optimal level of crime prevention to car designs. Whether inadvertent or not, the manufacturers saved on costs at the expense of the public. The result has been millions of car crimes of various sorts. It is certainly plausible to suggest that auto manufacturers could be encouraged to build in crime prevention to their products that would produce a significant reduction in crime and a major reduction in cost experienced by society as a whole.[4] A cost-benefit analysis would tease out the specifics and propose a level of taxation, fines or other regulation, that might encourage manufacturers (and/or designers of products, buildings and environments) to reduce the level of criminal opportunity supplied by their products, while accounting for the costs of doing so (such as increased consumer prices and/or reductions in profit from automobile production) from changes in the supply of automobiles). If it is argued that the creation of criminal opportunities also causes criminality by encouraging offenders to commit crime and to accelerate a criminal career, then the social cost is even greater. Many examples of crime externalities exist, and the argument could be made that some types of crime (but not all — it would be difficult to categorize domestic violence as such) should be viewed as forms of pollution (Farrell, 2000). This application of CBA may have potentially significant implications for the cost-benefit analysis of crime prevention and for crime policy as a whole. The issue is returned to later in this essay.

Limitations of CBA

Formal CBA has four implicit restrictions. First is that the goal of a cost-benefit analysis is to compare the current state of affairs to one where the market is expected to behave *more* efficiently. Programs that sacrifice efficiency for effectiveness (specialized courts such as drug courts tend to fall into this category) are much more difficult to evaluate. Second is the fact that the effects being studied have to include a change in the behavior of either the consumer of the good or the producer of the good or both. In the absence of a behavioral change, cost-benefit analysis is unnecessary: it is simply an exercise in accounting. Third, cost-benefit analysis is often performed in situations where information is imperfect: therefore the analyst must perform the analysis with caution and prudence, but preferably

without pride and prejudice. Fourth, it is assumed that producers and consumers will act rationally, at least according to the economic definition of rationality (maximization of utility). This last point can sometimes raise the hackles of readers unfamiliar with the territory. The most likely explanation for this is misunderstanding over the use of a range assumptions. Such assumptions are made to add clarity and manageability to a complex subject, and can be modified and adapted as necessary to fit different scenarios and conditions.

CBA and the Market for Crime

Economic models of crime are typically models of punishment, and equate risk with price, at least since the time of Becker (1968). The present model is of crime prevention rather than punishment, however. The next short section outlines how the relationship of risk and price differs in the crime prevention market model from its role in the traditional economic punishment model, since this is central to an understanding of what follows in relation to cost-benefit analysis.

Redefining Risk

As with the economic model of crime and punishment, price equates to risk in our economic model of crime prevention. However, in this model, risk explicitly incorporates elements of the time and effort required by an offender to commit an offence. Hence risk can be manipulated via a crime prevention intervention that increases the time and effort required to commit an offence. In the traditional punishment model of crime, variation in punishment was the principal means by which public policy could influence risk. In the present analysis, risk levels and the supply of criminal opportunities can be manipulated via policies and practices that influence the actual and perceived time and effort required to commit an offence. Other punishment variables are assumed constant in order that key influences upon risk, namely the supply and demand for criminal opportunities, can be perceived. While the emphasis here is upon crime prevention, a combined model that integrates prevention and punishment influences upon risk can also be envisaged.

Victim Surplus and Offender Surplus

CBA is a tool that is fundamentally concerned with measuring changes in surplus. In traditional analysis of social policy, there are two types of surplus: producer surplus and consumer surplus. With respect to the market for crime we adopt the terms Victim surplus'

and 'offender surplus,' respectively. A simple translation is to think (as proposed by van Dijk, 1992) of victims as the *unwilling* producers of a supply of criminal opportunities, and of offenders as the consumers who produce a demand for criminal opportunities. Hence victims are producers, and offenders are consumers in what follows.

A victim surplus is incurred since, at a given market level of risk required to commit an offense, some members of society would (unwillingly) supply criminal opportunities at a lower level of risk. That is, some targets would have provided some easier criminal opportunities. These potential targets decline in number as risk levels decline, down to a very small number who take virtually no anti-crime measures. These persons are society's free-riders, who have purchased less than the market level of protection (perhaps less guardianship or less security), so that the victim surplus is not a good thing for society.

An offender surplus is also incurred since, at any given risk level, some offenders would have committed crimes at a higher risk level. However, society loses since these higher-risk crimes are not committed. Therefore, if offenders are not allowed to stockpile reduced risk (i.e., offenders are made to commit riskier crimes closer to their highest level of risk tolerance), then society benefits from a reduction in offender surplus. Note that, contrary to what might be expected, society gains in the crime market from both a reduction in victim surplus and in offender surplus. This is precisely the inverse of a traditional market, where both consumer and producer surpluses are positive. Due to the manner in which these social costs operate, it is arguable that they might preferably be termed victim deficit and offender deficit rather than surpluses, but we retain the traditional terminology for simplicity in the present instance. In the market for crime therefore, the key is to realize that a reduction in victim surplus, or a reduction in offender surplus, is a good thing for society even though it initially sounds counterintuitive.

How does a crime prevention intervention produce a net social benefit? Society experiences a net social benefit if an intervention yields a net reduction in victim surplus, a net reduction in offender surplus, or a combination of increases and reductions where there is a net reduction in overall surplus. This can be illustrated. Figure 1 shows an equilibrium in a market for crime where curve Si represents the supply of criminal opportunities by unwilling victims, and the curve Di the demand for crime by offenders.[5] The market has a level of risk shown by pi and a quantity of crime committed of qi. The victim surplus is described by the area 'A' and offender surplus by the area 'B.' Aside from the changes in terminology, this representation is, so far, essentially the same as that of a traditional commodity

market. For present illustrative purposes we discuss a crime market for theft of new automobiles. Into this scenario, a government intervention is introduced that encourages manufacturers to improve the level of security on new cars as they are produced. Such an intervention was described by Barry Webb (Webb, 1993) when government legislation made car steering wheel locks mandatory.[6, 7] Due to the intervention, the level of risk that offenders incur to commit a car theft has increased in the aggregate. This is shown in Figure 2 as an inward shift in the supply curve, representing a reduction in the supply of criminal opportunities, from Si to S2, and an increase in risk from pi to p2. As a result, the number of crimes committed falls from qi to q2.

The government intervention to reduce the supply of criminal opportunities for a given level of risk has clearly reduced crime. The net social gain however, is shown by the changes in surplus. Victims have lost the surplus described by the shaded area 'C in Figure 2, which represents a benefit to society (less low-security potential targets since all new cars are now safer). Victims have gained, and offenders lost, the surplus described by area 'D.' Area 'D' is a transfer and represents no change in net social welfare. Offender surplus is reduced by the checkered area 'E,' also representing a benefit to society. In this simple model, whether society gains or loses in the aggregate as a result of the intervention is dependent upon the relative sizes of the cost and benefit components shown as areas C (social benefit), D (transfer) and E (benefit). In Figure 2, a net social benefit is produced since the additional surpluses from area C and E are removed, which in this inverse model is a good thing. Hence, the crime prevention intervention shown in Figure 2 produces a net social benefit.

The simple model presented here shows effective crime prevention behavior where only positive behaviors are produced. The price of crime (risk) increases, and the quantity of crime decreases (from qi to q2). It would be similarly simple to show the converse and manipulate these models to show costs to society. In the case where both supply and demand shift, and the elasticities of one or the other also change, it is theoretically possible to conceptualize a net increase in overall surplus, leading to a net loss in social welfare.[8] The challenge to researchers is to model the various components of these changes, and it is proposed that the crime and prevention model has the potential to be adapted to a range of such purposes.

Figure 1
Pre-intervention
Market for Car Theft

Risk (price)

S_1

B

p_1

A

D_1

q_1

Q (Quantity of crime)
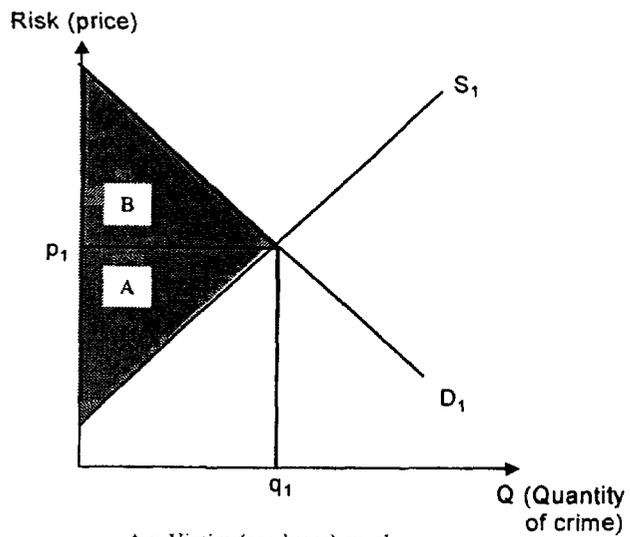
A = Victim (producer) surplus

B = Offender (consumer) surplus

Figure 2
Post-intervention Market
for Car Theft

Risk (price)

S_2 S_1

E

D

p_2

p_1

D_1

q_2 q_1

Q (Quantity of crime)
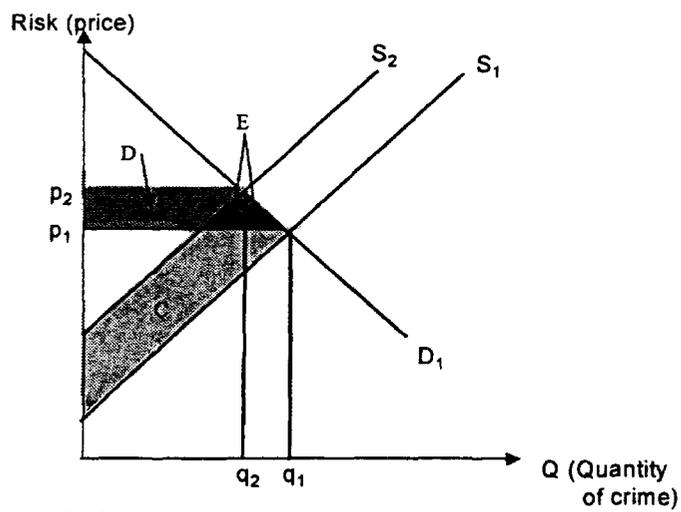
C = Lost victim surplus (a benefit to society)

D = New victim surplus / Lost offender surplus (transfer)

E = Lost offender surplus (a benefit to society)

Note: Supply of criminal opportunities is reduced from Fig. 1 to Fig. 2. Since C + E > 0 then net social surplus is reduced (i.e. net social gain).

Elsewhere, the mechanisms by which crime prevention produces shifts in the supply of criminal opportunities and demand for offending have been described in more detail (Farrell et al., 2000). Increasing the time and effort required to commit an offence, and reducing the supply of criminal opportunities, increases the market risk-price. Reductions in the rewards derived from an offence however, produce a decrease in demand for offences at a given level of risk (since it is less profitable while equally risky). In contrast, an increase in crime is likely to result from an increase in the volume of consumer goods that are suitable for theft. This tracks the mechanism described by routine activity theory, producing an outward shift in the supply curve, and an increase in the supply of criminal opportunities. From a crime prevention perspective, therefore, since more consumer goods typically produce more suitable targets, society might aim to produce goods that are less vulnerable to theft or other crime, and that therefore do not produce the same increase in available criminal opportunities. This is an issue returned to later.

From the basic crime market model that portrays victim and offender surpluses, a range of avenues for exploration can be derived. The elasticity of supply and demand are clearly important. For many types of crime, particularly those committed by opportunistic, unskilled, inexperienced and uncommitted offenders, the demand for crime will be quite elastic (a shallow demand curve). Here, an investment in crime prevention producing even a small reduction in the number of criminal opportunities on the market, or a slight increase in risk, would produce a disproportionately large net social gain. Professional, organized or highly motivated criminals might be expected to have a demand for crime that, while still fairly elastic for the most part, would be less elastic than that of opportunistic offenders. The crime market model would show how the offences they commit would require a more substantial crime prevention effort to produce increases in risk sufficient to prevent or deter these offenders. The simplified supply and demand curves shown as straight lines in Figures 1 and 2 would more realistically be expected to be complex functions. The related issues of the influence of crime displacement and the diffusion of benefits, and the net social cost or benefits that result, are areas outside the purview of the present essay, but present potentially rich veins for exploration by further research.

IV. MEASURING NON-MONETARY COSTS

CBA for crime prevention is not without areas of unresolved debate. The issue of the measurement (or not) of non-monetary costs is

a key area of concern. Can and should the psychological and other 'emotional' costs including, potentially, various forms of stress disorder, be incorporated into cost-benefit analysis of crime prevention? To date, the default option for CBA of crime prevention has been to exclude the non-monetary costs of crime. The justifications for this approach vary: sometimes no explanation is given, sometimes the justification is that estimates are not available, sometimes non-monetary costs are deemed irrelevant, and sometimes they are deemed impractical to incorporate since the estimates vary widely. Further, the debate is not confined solely to the field of crime prevention. The more popular debate over the 'costing' of a human life also relates to a range of policy areas, particularly that of public health provision and insurance. It remains a contentious issue (see *Economist* [2001] for a short summary relating to the health debate).

The debate over non-monetary costs is reflected in the terminology. Terminology varies from the optimistic term 'non-monetary costs' (which implies they can still be estimated and compared to monetary costs via a common metric), through 'intangible costs' (which recognizes their existence but seems skeptical of measurement), to the more pessimistic term 'unquantifiable costs' (which, as the name implies, suggests they cannot be quantified and therefore, for policy purposes, effectively do not exist).

Whether to include, and if so, how to measure non-monetary costs, are important issues for the study of crime prevention and for crime policy in general. Two key and related questions seem to underpin the debate The first is: 'Are non-monetary costs important enough to warrant inclusion in cost-benefit analysis?' The second is: 'Can non-monetary costs be estimated?' These questions are tackled after a brief look at the methodologies associated with estimating costs.

Estimation Methods

In general, the economic literature suggests the use of a "shadow market" to evaluate the costs associated with a transaction for which no market exists. A shadow market is typically some existing market that is analogous to the market to be evaluated. In general, there are two methods for evaluating the cost associated with crime (see Gramlich, 1981; Rajkumar and French, 1997; Cohen et al., 1994; Miller et al., 1996; Roman and Harrell, 2001). Each of these models attempts to use different shadow markets to measure a price associated with criminal incidents. The two methods are:

(1) *willingness-to-pay* estimates, which are based on the price one would be willing to pay to avoid damages, such as death or

disability, that result from crime. Methods of estimating willingness to pay include: *required compensation,* which estimates the price that an individual would have to receive in order to risk exposure to a dangerous event; *property-value,* where differences in crime rates and property values are compared to estimate the amount individuals will pay to avoid crime and its costs; and, *quality-of-life,* which estimates costs according to degrees of disability;

(2) *victim-compensation* or willingness to accept, the converse of willingness to pay. This is the aggregated amount that would have to be paid to a victim to compensate for his or her tangible and intangible costs. Methods of estimating willingness to accept include: *jury compensation,* which values victim costs at the rate juries compensate victims of crime, including health care, lost productivity and intangible costs such as pain and suffering; *discounted future earnings* estimates, which are based solely on the costs (or averted costs) of lost productivity due to an incident; and *cost of illness,* which uses survey data to aggregate the tangible cost of crime, including health and productivity [Roman et al., 1998].

To date, there is no best practice in benefits estimation, but the most common method of estimation has been victim compensation as estimated by cost of illness As Rajkumar and French (1996) note, this method tends to underestimate true costs because no intangible costs (pain and suffering, fear) are included in the estimate. However, given the high degree of uncertainty in measuring intangible costs, it is often thought to be prudent to exclude them. When it comes to crime, however, the substantial extent of intangibles means that their exclusion in some instances produces potentially misleading findings. The next sections tackle the two questions raised above regarding the issue:

(1) Are non-monetary costs important?

The answer to this question is an unequivocal V^{es}-' ^{For} crimes such as rape and domestic violence, the non-monetary costs of the trauma can be far more significant than any actual financial costs in many instances. To exclude non-monetary costs would reduce the apparent impact of these crimes many times over. In practical terms this will make these crimes less likely to be addressed by prevention initiatives, and, when the results come in, it will severely understate the gain derived from any crimes being prevented.

(2) Can non-monetary costs be estimated?

The answer to this question is a definite yes,' with the rider that the methods and techniques need to be replicated, revised, and improved upon. The pioneering Miller et al. (1996) work warrants further description in the context of suggestions as to how crime prevention evaluation might build upon it. Miller et al. utilized the victim-compensation model to show how the intangible costs of crime are, as might be expected, far more significant in relation to crimes such as rape than they are for crimes such as burglary. Regardless of the disputed merits of the victim-compensation approach, it is clear that rankings of crime according to their overall costs would be significantly influenced by the exclusion of intangible costs.

Table 1: Tangible and Intangible Costs of Crime

Crime	Tangible Costs	Intangible Costs	Total Costs	Cost Relative to Burglary	Ratio of Intangible to Tangible
Murder	$1,030,000	$1,910,000	$2,940,000	2,100	1.85:1
Rape/sexual assault	$5,100	$81,400	$86,500	62	15.96:1
Robbery/attempt with injury	$5,200	$13,800	$19,000	14	2.65:1
Assault or attempt	$1,500	$7,800	$9,350	7	5.2:1
Burglary or attempt	$1,100	$300	$1,400	1	0.27:1

At least one recent textbook on victims now routinely incorporates such measures in teaching the estimation of the costs of crime (Wallace, 2000:85, Table 5.3). Table 1 shows an adaptation of that presentation, itself an adaptation of the Miller et al. work. The table shows the tangible and intangible costs for five crime types. Tangible costs include medical costs, lost earnings, and public programs relating to victim assistance, which in the U.S. in 1993 were estimated at $150 billion. The intangible costs include pain, suffering and quality of life, which were estimated at $450 billion in 1993 (Miller et al., 1996). When intangible costs of crime are included, crimes come closer to what might be expected in terms of severity. The importance

of the intangible costs are clear upon an examination of Table 1. As one example, relative to the tangible costs, the intangible cost of rape is far greater than that for any other type of crime. The cost of rape would be significantly underestimated were intangible costs excluded. It should also be noted here, however, that these estimates are not necessarily definitive. In stark contrast to the value of life placed on murder victims shown in Table 1, one study of a drug dealing gang suggests that the value of the life of a low-level foot soldier may range from $7,500 to $110,000 (Levitt and Venkatesh, (1998:26). Even the higher of these values is far lower than the estimate of the total cost of murder shown in Table 1. While it may reflect differences in components that are costed, as well as methodology, the estimates may also reflect possible variation in the range of values that a life may take depending upon context and circumstances. While it is possible that average low-level drug dealers might value their lives at a far lower level than the average person, it is clearly there is a need for further work to reconcile these figures.

However, it is apparent that it remains standard practice to exclude non-monetary costs from crime prevention evaluations. This practice should change. The pace of change should be accelerated by further studies in this area. Work is needed to refine, improve upon and develop the methodology, and to use alternate methodologies to produce validating or improved estimates. This is required for different times, countries and contexts. Such research seems a necessary step if cost-benefit analysis of crime prevention is to become truly credible.

Nevertheless, the question of whether or not non-monetary costs should be routinely incorporated into CBA of crime prevention remains a tricky one. Ideally, if perfect estimates of those costs existed, they would be incorporated. At present, estimates can vary widely. Estimates can also be subjective: some people would argue that the life of a persistent violent criminal is not worth the same as that of a responsible hardworking taxpayer — the argument can be made that the net loss to society of the former is less than that of the latter. Many non-criminological debates exist, such as: is the life of an elderly person worth the same as that of a young person? Other issues arise in relation to such notions as 'the deserving victim,' such as the person who started the fight but lost. Such measurement issues should not be insurmountable however. This is evidenced by the fact that, at present, crimes of the same type are all implicitly valued equally when crimes are counted. Cases of multiple estimates would simply result in multiple cost-benefit outcomes, bounded by a confidence interval.

Discounting

Crime prevention was once brilliantly defined as the securing of a future non-event (Forrester et al., 1990). From one angle, the phrase also captures the need for 'discounting,' that is, converting past, present and future costs into comparable estimates. There is a time value associated with money: a dollar received today is worth more than that same dollar a year from now. Therefore, it is necessary to value benefits received in the future at something less than their current value. The degree to which future benefits are deflated is the discount rate.

The selection of an appropriate discount rate can be contentious (see Cohen [2000] for an extended discussion). Dhiri and Brand (1999) present a clear and practical statement of its derivation. Three main factors contribute to the formulation of a discount rate: the social rate of time preference; interest rates; and savings rates. The social rate of time preference is simply the rate at which consumers are willing to trade future for current consumption — it is a measure of the preference for deferred gratification. Interest rates and savings rates are linked, and together predict the rate of return to capital had it been invested rather than spent.[9] One factor that does not contribute to the discount rate is inflation, although inflation is often mistakenly used as the rationale for discounting.[10] Clearly, all three of these variables change over time, but a vast literature on discounting helps inform the setting of an appropriate rate.

The applicable discount rate varies over time and space. In the U.K., Dhiri and Brand note that "[t]he standard real discount rate currently used in central government is 6 per cent" (1999:43). In the U.S., it is generally accepted that any discount rate between 3 and 4% can be assumed to be unbiased.[11] The definitive U.S. text on cost-benefit analysis proposes applying various discount rates to a problem in order to generate the equivalent of confidence intervals (Gramlich, 1988). Assuming for present purposes a social rate of time preference of 2%, and a current interest rate of 5%, this discount rate of four percent should offer an appropriately conservative estimate of future benefits. Future benefits are therefore calculated according to Equation 1, where (X$_T$) is the benefit (cost) occurring in year T and the discount rate is .04:

$$\text{Discounted Future Benefits (DFB)} = \sum_{0}^{T} \left(X_T / ((1 + D)^T) \right) \qquad (1)$$

Using this equation, each averted crime is discounted for each year during which a benefit is expected to accrue, as determined by

the average duration of the intervention (in years) for each type of crime. In Painter and Farrington's (1999) impressive study of the impact of street lighting on crime, for example, street lights had a life expectancy of 15 years, which was therefore the time over which benefits were expected to accrue. A textbook illustration demonstrates the power of discounting. Suppose one were offered the choice between receiving one dollar a year forever at a discount rate of 5%, or $20 at present. It turns out that taking the money up front is a better deal. In fact, in the distant future, after 20 years, the payoff is vanishingly small.

Putting it All Together — And Looking Beyond

When all of these factors are put together, a rather complete picture of a cost-benefit model of crime prevention emerges. It may well be that supply and demand for some criminogenic goods can be readily generated: the number of cars stolen annually can be used to estimate a demand for stolen cars. Police records on prices received for stolen goods might be used to calculate prices. On the supply side, survey data might be used in combination with consumer purchase data to model the 'supply' of anti-theft devices for cars. Multivariate analysis can be used to control for outside factors, such as changes in policing and changes in standard prevention equipment. It is possible that sophisticated models could be developed. Such models might predict how changes in consumer behavior produce changes in the volume of crime.

Another approach may be to apply these same tools at a more micro level, by examining changes in behavior, say, before and after a crime prevention program is implemented. This approach would use the same methods described above, but would use multivariate techniques to isolate the effects of the program. Here, key variables are developed from knowledge of how a program would operate. Costs can be readily tabulated, using market costs for labor, facilities and other costs. An outcome evaluation could be conducted in the usual way, isolating program effects using (quasi) experimental techniques. The 'cost of illness' method (mentioned earlier in relation to victim-compensation method of estimating costs), could then be combined with the outcomes from the evaluation to put dollar values on changes in behavior, by, for instance, creating estimates for the benefits received by society from a car not being stolen. More specific recommendations for conducting these evaluations are beyond the scope of this paper. (See Roman et al., 1998 for further details of such a program as they relate to court-based interventions.)

V. ROUTINE SAVINGS

This section notes some obvious crime prevention efforts that are clearly beneficial but which have not been subjected to cost-benefit analysis. They are often revealed as beneficial by the preferences of those who choose to adopt them.

Case Study of the Car Door

Upon leaving their motor vehicle, most informed people will lock the door. This is because the benefit of locking the door outweighs the cost of the resources expended. The cost (effort) of locking the door is small compared to the potential cost of car crime, even if the risk of car crime is small. In time, locking the door becomes routine, the effort-cost appears miniscule and is outweighed by the psychological benefit of knowing the door is locked, as well as by the actual benefit of reduced crime risk. Locking the door becomes a sensible routine precaution (Felson and Clarke, 1996), so much so that it is often not noticed as an explicitly proactive crime prevention activity.

A car door is more likely to be locked if the car owner has a remote locking device.[12] Just as with doors that swing closed and lock behind you, such facilitators of crime prevention increase the implementation of routine crime prevention. The equivalent in the field of health and safety is the fire door that automatically closes after entry. In both instances, the effort-cost of closing/locking the door is reduced. If costs decrease, net benefit increases. In the model described earlier, this would be shown as a shift inward of the supply curve, reducing quantities of crime and increasing the risk-price.

The car door is one simple example of a routine saving — in terms of costs and benefits — from precautionary crime prevention measures. There are many more, from locking the front door to carrying keys in hand while approaching the car. Taking a cab can often be an implicit crime prevention measure, as can an unwillingness to walk through certain areas at certain times.

So What?

The observation that routine precautions have not been the focus of CBA is significant. It shows that a range of simple and obvious cost-benefit analyses can be undertaken that will empirically demonstrate where benefits outweigh costs. This may allow the study of CBA to progress to a more fruitful stage of focusing upon where and when crime prevention is most beneficial, rather than focusing upon whether or not it is beneficial.

VI. EXTERNALITIES: COST-BENEFIT ANALYSIS AND CRIME POLLUTION

Manufacturers of mobile telephones have a range of possibilities open to them to discourage theft of their devices (Clarke et al., 2001). Car manufacturers have, for many years, had huge variation in their propensity to install anti-theft devices on vehicles. Some manufacturers choose not to implement crime prevention measures in their products because they would incur a small increase in manufacturing costs. It should not, but seemingly still does come as a surprise, that knowingly selling large volumes of criminogenic products results in huge amounts of crime. Arguably this also produces further negative knock-on effects: the expansion of criminal opportunities increases the pool of offenders who pass the tipping point where their perceived utility for crime is greater than the perceived risks —because the 'good' experience shifts those perceptions towards a preference for crime.

As a result, crime research might consider examining the costs and benefits of the absence of crime prevention, rather than solely the costs and benefits of its presence. Doing so may prove that the analysis of the costs and benefits of the absence of crime prevention holds the potential to be a powerful and influential tool by which the baseline of crime prevention standards can be moved upwards.

Focusing upon the well-known example of car manufacturers, the range of crime prevention options available to reduce car theft is fairly large, including: steering-wheel locks, entry codes, alarms, immobilizers (e.g., "the Club"), and tracking devices. Theft of cars for their parts can be made less rewarding by the indelible stamping of identity codes on the most valuable body and engine parts. Admittedly, recent technological advances have made many of these available only in recent years. It is also evident that some measures — a good example is steering-wheel locks — have been introduced as mandatory in some countries. It was clear to all concerned, including policy makers, that the aggregate social benefit of mandatory crime prevention standards was greater than the aggregate social cost of their absence. Hence steering wheel locks became widespread. Barry Webb (1997) briefly describes the fascinating history of car crime and efforts to overcome it — the earliest of which were registration numbers. What is not mentioned is that cost-benefit analysis was implicit to these legislative moves. To policy makers it was clear that the net social benefit of the legislation would far outweigh the crime cost of inaction and the absence of the crime prevention measure. It was also clear that by forcing manufacturers to internalize the crime prevention cost was the means by which to produce the largest net so-

cial gain. It appears that there may be a need to develop and apply a methodology that identifies areas where the absence of crime prevention leads to a net social welfare loss.

Externalities

The discussion of market failures that follows needs a brief introduction to the concept of externalities. In general, externalities can be positive or negative, and they arise in situations where a consumer not involved in a transaction is affected by that transaction. Two types of externalities occur. Pecuniary externalities occur where the actions of an actor in the market affect others in the market, and these effects are transmitted in the market, for example by a change in price. This would occur, for instance, where a polluter (probably a regulated monopolist) charges below-market prices to compensate consumers for the deleterious effects of the pollution. Using the automotive examples, this would occur where a manufacturer of a criminogenic good, such as cars, charges a price slightly below the market price to compensate consumers for the costs they face because the manufacturer does not include anti-theft protection.

The other type of externality, the far more common example, occurs where the externalities are orthogonal to the market, and therefore the actions of one actor affect the welfare of others, but there is no market price for that effect. Following the two examples above, this would occur where a polluter does not account for negative pollution externalities in setting a price, or where a car manufacturer excludes prevention technology, but does not compensate consumers for their net loss in social welfare due to increased theft by selling below the market price. If producers simply charge a lower price for a car without anti-theft technology (i.e., with a pecuniary externality), then we have a 'so what' or trivial situation. While this is a empirical question that can, and should, be tested, we suspect that few manufacturers do so.

One other construct deserves explanation. Should the latter situation occur, we are still left with something of a quandary about the appropriateness of third-party (e.g., governmental) intervention. Conservative scholars would likely argue that the market provides solutions to these problems over time, and that most interventions lead to some loss in net social welfare through less efficient markets, and through administrative costs. Without debating these points — and they are eminently debatable — few argue that intervention is inappropriate in the case of public goods. While this discussion is not central to the issues addressed here, crime prevention is, at least in part, a public good. Public goods have two general qualities: they are

non-rival (the use of a good by one does not affect the use by others), and are non-exclusive, i.e., everyone is affected. In the case of crime prevention, it is clear that at the macro-level, a program that reduces some crime reduces some crime for all (i.e., it is non-exclusive). It is also clear that crime prevention is, in many instances, non-rival: my use of crime prevention has no effect on your use of it as well. The exceptions might be free-riders and followers. Free-riders seek to benefit from the crime prevention behaviors of others, and underinvest in crime prevention. What we term 'followers' would be people who adopt extra crime prevention measures either to "keep up with the Joneses" or in case they feel that the prevention behavior of others may leave them as the only vulnerable target. The question to answer is whether there are market failures in the provision of crime prevention, and whether crime prevention is a public good. Leaving the latter question aside, in the remainder of the paper we argue that such market failures do exist.

Market Failure

Another of Webb's (1997) examples relating to car crime is the eventual widespread incorporation of locks within car doors, to reduce the ease of theft. This measure was introduced by manufacturers without legislation. It was clear to manufacturers that the extra production costs would be outweighed by the benefit from sales. Thus, it was not due to the benevolence of the car manufacturer that locks were introduced. It was from the pursuit of their self-interest, a response by the market to the fact that consumers prefer a less crime-prone vehicle. In this example, the invisible hand of the market locked the door. However, this example is illustrative more of the exception than the rule: it is more typical that the pursuit of economic self-interest does not lead to crime prevention. It may be more typical that the market fails due to a lack of recognition of the negative externalities associated with the absence of crime prevention. Consumers are typically not well informed either about risks or crime prevention measures. The market equilibrium for in-built crime prevention may be different from that which would maximize overall social welfare. That is why vehicle registration and steering-wheel locks were introduced via legislation rather than via the market.

A Pigouvian Tax for Crime

Alfred Pigou (1877-1959) is credited with being the first to advocate a tax upon industry that produces negative externalities. Hence, manufacturing industry incurs a Pigouvian tax for illegal pollution.

Such a tax forces manufacturers to pay the cost that they are imposing on society. Since it is cheaper to lower the level of pollutants rather than continue to pay the tax, manufacturers quickly internalize the cost by shifting to a less-polluting production process. A Pigouvian crime tax might encourage manufacturers to reduce the level of the viability of products. It could also be used to encourage crime prevention through environmental design (CPTED: see Jeffrey, 1977) and the more routine avoidance of crime facilitators.

Many adaptations to manufacturing processes that might reduce crime would do so at relatively low cost. The cost to the manufacturer of a few pennies would, in many instances, have been largely absorbed during the mark-up process between production and distribution. Yet clearly, such an approach should not be so interventionist so as to interfere with the market, its incentives and its profits. Reducing market efficiency is, firmly, not the aim of these proposals. The avoidance of a specific instance of market failure as it relates to crime — where manufacturers impose large external costs on society in order to reap small rewards for themselves — is a more desirable objective. There should be scope for policy that can meet a Kaldor-Hicks standard whereby manufacturers could be reimbursed from gains by consumers.[13] Victims will be the principal beneficiaries, but society as a whole will benefit, particularly if there is a diffusion of the crime prevention benefits across society. It is not unlikely that, in the long run, manufacturers would also benefit as overall market sizes increased due to consumers moving into markets where crime had previously deterred them from spending.

It is perhaps not over-optimistic to envisage a future in which manufacturers and designers routinely incorporate crime prevention know-how during the development stage. In the near future, white and other electrical goods may have wireless (bluetooth) technologies installed. Such technologies may allow goods to be located to a particular venue, and either traced via a centralized registry or perhaps disabled if reported stolen. One means of encouraging manufacturers to routinely incorporate such wireless anti-crime devices would be through the use of government purchasing power (GPP). If suppliers to government were obliged to incorporate such measures routinely, then it is likely that their transition to the remainder of the market would be speedy.[14]

Developing Pigouvian taxes would require much thought and consideration. Their specifics are outside the scope of this essay. It is not acceptable to impose unreasonable costs upon manufacturers unless the gains are certain. Moreover, such legislation could present difficulties in the context of international markets: higher crime prevention standards in one country could appear as a barrier to entry to

products from elsewhere. As with any innovative and potentially beneficial policy, it would not be without critics, and would require great skill in development as well as implementations. Cost-benefit analysis could inform its development as well as evaluation.

A tax to reduce crime externalities would need to be policed. This could take different forms. It could be incorporated into the activities of the police, within existing resources. Perhaps it might be appropriate to develop it within an existing agency undertaking similar activities, such as the Environmental Protection Agency or the Consumer Product Safety Commission. A third alternative might be the development of an independent crime by-product monitoring agency. In the U.K., the strategic development of such a tax and its monitoring (policing) might properly be considered within the domain of the Foresight crime prevention initiative of the Department of Trade and Industry.

What would a broader recognition of the implicit costs of the absence of crime prevention suggest for cost-benefit methodology as applied to crime prevention? First, it would mean a shift in emphasis. CBA relating to add-on crime prevention efforts and projects would continue. In addition there would be CBA to identify products and environments that encourage potentially available crime; and where the costs of avoidance are trivial in comparison to the costs of the crime, a solution would be mandated. This would require an assessment of the current benefits (to manufacturers who save on production costs) in relation to the external costs that the manufacturers impose upon society in the form of crime relating to those goods. Such analyses could provide powerful information that could be directly used to try to implement and encourage built-in crime prevention.

In developing policy responses to reduce the criminogenic qualities of consumer goods, and hence to reduce the supply of criminal opportunities, there may be much to be learned from the progress and pitfalls encountered in relation to environmental protection. In recent years, command and control interventions seem to be beginning to give way to market-based instruments and incentives that encourage reductions in various types of pollution. The market-based instruments seem to come in four basic forms (see, e.g., *Economist* [2001] for a brief overview, or the edited volume of studies edited by Portney and Stavins, 2000). The first is 'tradable permits' whereby companies that produce less pollution than they are permitted to by the government might sell their credit to other companies. It could be fruitful to think through the permutations of 'allowing' car or mobile phone manufacturers, or credit card issuing companies, only a certain number of thefts of each model. Tradable permits, such as acid

rain allowance trading programs under the Clean Air Act amendments of 1990 and those included in the Kyoto protocol, are designed to spur innovation and are commonly believed to have led to significant reductions in environmental pollution levels in some spheres (Stavins, 1998). The second market-based instrument for change is taxes and charges'. In relation to crime, taxes and charges would alter the prices of good to reflect their crime risks. One possibility might be that the government reduces taxes on goods that have low crime rates and leaves taxes on criminogenic product lines that produce a social cost — along the lines of the Pigouvian tax discussed above. In environmental economics, the third type of market-based scheme is 'the reduction of environmentally-harmful subsidies,' and the fourth is 'the reduction of barriers to the creation of new markets.' While we do not suggest crime-control related policies or examples modeled upon these environmental protection policies, this does not mean that they do not or cannot exist. A significant area of future research may lie in exploring the possibility of applying environmental protection-type policies to the spheres of crime control and prevention. A first step might be for the appropriate government agencies to convene a meeting of environmental protection and crime prevention experts, to encourage cross-fertilization in this arena, and to develop a policy-informing research agenda.

VII. OPPORTUNITY COSTS OF THE FAILURE TO INTRODUCE CRIME PREVENTION — A BRIEF CASE STUDY OF CCTV

This section discusses an issue that is different from externalities, and relates to the fact that the absence of crime prevention in a given situation incurs opportunity costs that are often overlooked. This key issue is demonstrated through the following brief case study relating to CCTV, although the concept applies more generally.

There is now a body of accumulated knowledge demonstrating that closed-circuit television (CCTV) can, when properly implemented and monitored, be effective at reducing crime (see the edited volume by Painter and Tilley [1999], for example). There is also evidence that CCTV can be introduced without infringing upon people's freedoms — providing necessary control mechanisms are put in place to ensure that those monitoring the screens are trained and follow protocols that mean they cannot abuse their position.

CCTV has been shown to reduce crimes of different types under a range of different circumstances. The benefit to victims and to people in general is clear, since crime is reduced and fear of crime is re-

duced in high-crime areas that are now at least partially protected by CCTV. The freedom of people to move around — particularly since women and the elderly are often likely to modify their behavior to avoid potentially risky areas — is arguably increased. At the same time however, some commentators, particularly in the U.S., still object to CCTV on the grounds of civil liberties. The argument that CCTV infringes upon a person's right to anonymity is that this loss of freedom is a social cost. Opponents answer that this is essentially an argument for a right to anonymously commit crime. However, a more compelling argument may be that policy makers should not ignore the opportunity costs (crime saved, fear reduced) incurred by deliberately failing to introduce a proven crime prevention measure. The role of cost-benefit analysis in this area would be to more formally explore, delineate and quantify the opportunity costs, and to compare them to the 'benefits' of failing to introduce CCTV. Such an analysis may prove that the identification of the opportunity costs of the absence of crime prevention is a general tool that can be utilized to encourage the implementation of crime prevention efforts.

VIII. CONCLUSIONS

The time is ripe for significant progress to be made in the field of cost-benefit analysis as it relates to crime prevention. Things are already beginning to move: the standard for practitioners conducting cost-benefit analysis of crime prevention has clearly been set by the clear and concise monographs of Dhiri and Brand (1999) and the follow-up by Legg and Powell (2000). Welsh and Farrington (1999) have reviewed 13 published cost-benefit analyses with a timely thoroughness. Although it may take some time to become widespread practice, Miller et al. (1996) have paved the way for non-monetary costs to be routinely incorporated into CBA of crime prevention, and, although much further work is clearly required, Farrington and Painter (1999) have initiated moves in this direction.

It is also apparent that cost-benefit analysis has applications for crime prevention that move beyond the existing focus of project and program evaluation. There may be a range of existing crime prevention evaluations that can be retrospectively assessed in terms of costs and benefits. To do so would be, relatively speaking, a cost-efficient exercise in terms of the knowledge derived. We suspect that, should the successful cost-benefit analysis that is implicit to many studies prove founded, it would provide evidence to add to the accumulating body of knowledge that situational crime prevention "works.' It would also be a quick and easy means of accelerating the study of crime prevention to a level that is credible and comprehensible to

those who are influential in public policy decision making. A small demonstration project could assess whether such studies exist, prior to launching into a full-scale assessment of their costs and benefits. An on-site set of research information such as that which must exist within the Research and Statistics Directorate of the U.K.'s Home Office, would seem an appropriate location for such a project.

Cost-benefit analysis of routine activities needs greater delineation. How does an activity or a measure become 'routine' rather than special or unusual? In some cases it must be related to costs of products that facilitate crime prevention (such as 'smart' library and supermarket checkouts that reduce theft at the same time as accelerating processing speed). Efforts at crime prevention education campaigns (lock it or lose it') imply that routine crime prevention practice can be encouraged.

There is a potentially rich vein of research to be undertaken in relation to crime externalities. Noise is a form of social pollution, and some forms of crime might be viewed through a similar lens. Where manufacturers produce criminogenic products, there is scope for the argument that, by failing to incorporate crime prevention measures, they make minor cost savings at the expense of a larger cost to society. Many precedents exist where such an analysis has been implicit to legislation even if not explicit. Somewhere down the line a form of Pigouvian tax on crime might be considered to encourage the internalization of crime costs, and the relevant monitoring agency identified or developed. Cost-benefit analysis is the appropriate research vehicle for developing such an approach. The related aspects of the field of environmental protection holds the potential to significantly inform these areas of crime control policy.

Counting crimes will never go out of fashion. It is easy, and everyone can understand how many crimes have occurred. However, research on crime requires a common metric via which crimes can be compared. It is likely that the overall social cost of crime is the best common metric. The net social cost approach allows crimes to be compared directly. Miller et. al.'s (1996) work would suggest that, ceteris paribus, preventing one rape is preferable (in cost-benefit terms) to preventing 62 burglaries. A common metric that incorporates non-monetary costs allows the impact of crime prevention measures for crimes of different types to be discussed and evaluated on the same terms. This should allow crime policy to move towards an overall harm reduction approach (where harm is defined as lost social welfare due to crime), rather than the current haphazard approach.

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APPENDIX A:
KEY DEFINITIONS

(Reproduced from Dhiri and Brand, 1999)

Inputs are defined as any additional human, physical and financial resources that are used to undertake a project. For example, in an intervention that installs fences across paths at the backs of houses as a target hardening measure to prevent domestic burglary, inputs would include the materials and labor used to install the fences.

Outputs are defined narrowly as the direct products of the process of implementation. They can arise only during the implementation period. Following the above example, the fences installed are outputs and the number of fences installed is an output measure.

Impacts on risk factors are defined as the effects of outputs that *disrupt the causes of criminal events.* Measuring such impacts is therefore a way of monitoring the process through which the intervention is expected to reduce crime. In our fence example, this could be a reduction in non-residents entering the path, thereby reducing the opportunity for burglary.

Outcomes are defined as the consequences of the intervention. These can arise both during and after the implementation period. Key outcomes will relate to the stated objectives of the intervention. In our example, the reduction in burglaries attributable to the installation of fences is the primary outcome. But there are likely to be wider outcomes such as a change in the fear of crime or the reduction in other types of crime. These wider outcomes may or may not be measurable and can be negative as well as positive.

Costs are defined as the monetary value of inputs. Outcomes resulting in negative costs attributed to a program are considered to be benefits.

Benefits are defined as the value of outcomes to society that are attributed to the intervention, expressed in monetary terms. Negative outcomes attributed to an intervention will be referred to as costs.

APPENDIX B:
UNIT OF ANALYSIS

The two key constructs in choosing a unit of analysis are the concept of transfers and opportunity costs and benefits to participants. The idea that costs can be shifted across agencies is not a particularly important insight. However, in practical application, this can create a great deal of difficulty in formulating a cost-outcome analysis. A transfer' is simply the shifting of resources from one entity to another. Determining how to account for these transfers can be difficult.

An example will help clarify this issue. If a crime prevention project team assume a part of a facility that was already being used and paid for, (for example, in a police station) but the project does not pay for the facility, then the facility has been transferred to the crime prevention project. If it is assumed that all benefits of the crime prevention project accrue to its public flinders, and implicitly the tax-paying public, then it is not necessarily clear how to account for the transfer described above. While the use of the facility clearly is a new cost to the crime prevention project, regardless of whether there is an actual cash outlay, it is not a new cost to the system. If, for example, a crime prevention initiative is funded by the federal or national government, and local government funders (and tax payers) are selected as the unit of analysis, it appears that no cost is incurred by the program. On a larger scale, it is not clear how to attribute the costs of any publicly-funded social program. If no new taxes are required to fund a crime prevention project, than it is not clear that any cost can be attributed to the program, as all funds are simply shifted from an existing public agency.

While the notion that no new costs have been incurred in most public enterprises is technically correct, it is practically specious. Returning to the initial example, there clearly was a cost to the transfer of facilities to the crime prevention project, in that space could have been used for some other activity that would have likely derived some benefit. As such, it is appropriate to consider such transfers as costs to the crime prevention project. In general, it is appropriate to use the analogy of new versus old costs when considering how to apply costs. If a cost occurs as a function of the crime prevention project operations that would not have occurred in the same way had the project not been operating, then it is generally necessary to count that cost.

Next, costs and benefits that accrue solely to program participants must be considered. Consider the instance of a market reduction approach (see, e.g., Sutton et al., 1998) in which there is a crackdown on second-hand sales of stolen goods in a community. Sellers of second hand goods may be foregoing substantial illicit income, as are local consumers who do not benefit from the cheaper-than-legal purchases that were previously available. On the other hand, it may be the case that as a result of the program, a secondhand store gains credibility with the public and increases its legal business as a result. While many analysts may be loathe to include the former as a cost of the program, there may be a preference for including the latter as a beneficial knock-on effect of the intervention. Many analysts recommend excluding both from the analysis.

The final concept in considering a unit of analysis is that of maintaining consistency across both costs and benefits. If, for example, if the unit of analysis selected is the city, then benefits accruing as a result of program operations must be carefully scrutinized. If benefits accruing as a result of program operations include more legal sales from stores, then increases in national or federal sales taxes cannot be considered a benefit. Since it is sometimes extremely difficult to make these judgments, it is generally recommended that the broadest unit of analysis be selected.

NOTES

1. For comments on earlier versions of this paper we are grateful to Nick Tilley, Ken Pease, Paul Ekblom and Peter Reuter.

2. This opening paragraph is really an homage to Jane Austen's satire of 19th century marriage (Austen, 1813 (1997): 1).

3. Some commentators aim to define aspects of corrections and probation efforts, youth education programs, court programs and other things as 'crime prevention'. We prefer to call them corrections and probation efforts, youth education programs, courts programs, or other things as appropriate. Just as health and education policy, public holidays and pink ribbons may indirectly influence the crime rate, their main aim is generally not crime prevention, and we do not label them as such. We acknowledge that some offender-based measures and policies may have an implicit or explicit component of criminality prevention, which may (or may not) indirectly influence the crime rate. However, we also acknowledge that criminality prevention is not the same as crime prevention, not

least since other likely offenders may be tempted to take up existing criminal opportunities. Further, 'situational' crime prevention is, in truth, probably the main form of criminality prevention that exists in society, but most criminologists quietly overlook this basic fact.

4. Car manufacturers are certainly making anti-theft devices more standard on cars. Intervention to speed the process several years ago would arguably have avoided millions of car crimes.

5. In the figures, the supply and demand 'curves' are linear for simplicity.

6. This example highlights the issue that there may be a strong case for developing retrospective cost-benefit analyses of crime prevention interventions, such as the introduction of steering wheel locks.

7. This case is actually rather more complicated than presented here, as there is likely a cost to society for this program in multiple ways. For example, consumers likely bear some of the direct cost of the program in the form of increased taxes or fees. Second, this program likely makes the market somewhat less efficient, to the extent that both consumers and producers share the cost of the program, leading to higher prices for cars obtained *legally,* leading to a net loss of social welfare. However, a full treatment of these phenomena is beyond the scope of this discussion.

8. For example, suppose the change from Si to S2 included both a shift as noted in Figure 2, and a change in the elasticity of supply (where the supply of crime prevention became relatively more elastic, i.e., where a small change in price yielded a relatively large change in quantity). In this new model then, the price change might remain the same (i.e., decrease from pi to p2 as shown) but the quantity of crime would likely decrease more than is shown in Figure 1 (i.e., q2 would move closer to the origin). In this new model then, suppose that the supply curve now goes through the origin. This would split C into an area of lost surplus, and an area of gained surplus. If the area of gained surplus were greater than the area lost by both producers and consumers, than the net cost to society would be negative.

9. For more discussion about discount rates, see Gramlich (1981):88-115; Mendelsohn (1981):239-241; Kolb and Scherga (1990):381-390.

10. While any future benefits will be worth less in today's dollars as a function of inflation rates, inflation is not included as part of the discounting process. If a weight is attached to future benefits to account for inflation (numerator), this weight must be attached as well to the dis-

count rate (denominator), which will also be effected by inflation. The net result is that inflation adjustments cancel out. For more discussion, see Gramlich (1981):94-95.

11. As Gramlich (1981:108) notes, "Given the uncertainties in estimating either one of these rates, use of a real discount rate in the 3 to 4 percent range will probably yield present value solutions that come as close to being correct, or at least unbiased, as is possible in this messy area."

12. For present purposes it is assumed that remote locking devices increase door locking.

13. A Pareto optimal move is where nobody is made worse off but some people are made better off. It might be more realistic in this instance to produce a Kaldor-Hicks standard, where many people are made far better off for only a small internalized cost on the part of manufacturers and designers.

14. The discussion of both bluetooth technologies and the potential to use government purchasing power owe a large debt to discussions with Ken Pease.