Journal of Benefit-Cost Analysis

Volume 1, *Issue* 1 2010 *Article* 6

An Assessment of Important Issues Concerning the Application of Benefit-Cost Analysis to Social Policy

Aidan Vining, *Simon Fraser University*
David L. Weimer, *La Follette School of Public Affairs*

Recommended Citation:

Vining, Aidan and Weimer, David L. (2010) "An Assessment of Important Issues Concerning the Application of Benefit-Cost Analysis to Social Policy," *Journal of Benefit-Cost Analysis*: Vol. 1: Iss. 1, Article 6.
DOI: 10.2202/2152-2812.1013

An Assessment of Important Issues Concerning the Application of Benefit-Cost Analysis to Social Policy

Aidan Vining and David L. Weimer

Abstract

Benefit-cost analysis (BCA) provides a framework for systematically assessing the efficiency of public policies. Increasingly, BCA is being applied to social policies, ranging from preschool interventions to prison reentry programs. These applications offer great potential for helping to identify policies that offer the best returns on public investments aimed at helping the disadvantaged or otherwise improving social life. However, applying BCA to social policies pose a number of challenges. The need for a comprehensive approach to assessing social policies generally requires making predictions based on data from multiple sources and using available shadow prices. As these predictions and shadow prices are inherently uncertain, special effort must be made to explicitly address the resulting uncertainty of predictions of net benefits. Prediction and valuation are complicated by behaviors, such as addiction, that do not clearly satisfy the assumptions of neoclassical welfare economics. As distributional goals are often an explicit motivation for social policies, BCA may be an incomplete framework for public policy purposes unless analysts can find ways to incorporate people's willingness to pay for changes in the distribution of consumption across society. If BCA is to reach its potential for contributing to good social policy, analysts must be aware of these challenges and researchers must help address them.

KEYWORDS: social policy, addiction, benefit-cost analysis

Author Notes: The authors thank Richard Zerbe and especially Robert Haveman for constructive comments, and the John D. and Catherine T. MacArthur Foundation for its support.

INTRODUCTION: SOCIAL POLICY AND THE APPLICABILITY OF BENEFIT-COST ANALYSIS

Social policy can be defined as the laws, rules, directives, programs, and other instruments employed by government to increase investments in human capital, encourage behaviors with positive externalities, discourage behaviors with negative externalities, or reduce disparities in wealth, income or consumption. Social policy includes a range of substantive policy areas including early childhood development, education, physical and mental health, juvenile justice, crime and corrections, housing, income support and employment.

How should society assess the value of the vast array of interventions that are either proposed or operating in social policy arenas? Benefit-cost analysis (BCA) provides a framework for comprehensively taking account of the full range of social benefits and costs. Indeed, BCA is the only normative framework that claims to assess these costs and benefits comprehensively in an *explicit* manner. Although BCA has traditionally been applied primarily to infrastructure investments, economic regulation, and environmental policy, it is now increasingly being applied to social policy. (For a comprehensive review, see Weimer and Vining, 2009). The application of BCA to potential social policies requires prediction of the effects of investments of scarce resources by society and the valuation of these effects in a money-metric, normally present-value dollars. The purpose of BCA is to identify the most efficient policy. Efficiency simply means getting the most value from the resources available. It includes technical efficiency, which means producing things of value in ways that involve giving up the smallest amounts of other things of value. More generally, however, it concerns the allocation of resources to generate the largest aggregate value, as assessed by summing individual valuations across all members of society. A policy or policy alternative achieves optimal efficiency if no other policy can be identified that offers a larger excess of benefits over costs. Any policy alternative that would create greater costs than benefits relative to the status quo is clearly inefficient. For example, a policy that would inflict $400 million in costs but only $300 million in benefits would decrease, rather than increase, efficiency.

Because it is always valuable and important to understand the efficiency consequences of government interventions, including social policy interventions, there is no normative reason why these fundamental principles of BCA (and more generally welfare economics) should not apply to social policy. Therefore, we argue that *the standard principles of BCA should apply to social policy*. However, the application of BCA to social policy does raise a number of issues that deserve special attention in any effort to develop standards for benefit-cost analysts. Our specific charge from the Benefit–Cost Analysis Society was to "address general considerations in conducting a BCA of social programs, the need

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

for principles and standards for social programs and addiction in particular, and point out any special problems facing those doing BCA in the field of addiction. An ideal methodology will be suggested in so far as this is possible."

THE MAJOR ISSUES FACING THE APPLICATION OF BCA TO SOCIAL POLICY

After a comprehensive review of both the academic and more applied policy literatures, we identify four issues as especially important in applying BCA to social policy: (1) the need for a comprehensive approach to assessing social policies; (2) the need to recognize and explicitly address the great uncertainty in prediction and valuation involved in applying BCA in most social policy areas; (3) the need to consider those behaviors, which occur frequently in social policy, that do not satisfy the assumptions of neoclassical welfare economics, and (4) the application to policies that often have strong distributional goals and consequences. Before considering each of these issues in detail, we seek to justify their importance.

Every BCA should be comprehensive in terms of taking account of all valued effects in predicting net benefits. Achieving comprehensiveness poses a special challenge in applying BCA to social policies because many of their effects are difficult to predict and value. Social policies often have effects that spill over from one domain to another, such as education and health investments that affect human capital and work effort. They also often have effects that are likely to persist over long periods of time but are difficult to predict. For example, investments in early childhood (e.g., subsidies for enriched day care) may affect labor market productivity (e.g., earnings) decades after the investment, requiring predictions of a chain of effects leading from cognitive development through school achievement to employment. Social policies also often involve the reduction of negative externalities, such as crime, that require valuation. However, the appropriate metrics, or "shadow prices," for a number of these externalities are currently uncertain.

The ubiquity of uncertain predictions of effects and uncertain shadow prices for valuation make the explicit recognition of uncertainty especially important in the application of BCA to social policy. Comprehensiveness requires the valuation of all effects, including those that might not achieve conventional levels of statistical significance in particular studies. The challenge is particularly great when a single study provides a number of important estimates of effects and few of these effects have statistical significance under the rules of multiple comparisons. As the focus of BCA is the hypothesis that net benefits are positive, analysts appropriately incorporate predictions based on statistically insignificant coefficients if they take account of their standard errors in the

DOI: 10.2202/2152-2812.1013

creation of predicted distributions of net benefits through Monte Carlo simulations. Indeed, because of the many uncertainties in the application of BCA to social policy, we argue that an explicit consideration of uncertainty, through Monte Carlo simulation or equivalent methods, is essential.

Social policies quite often involve behaviors that do not necessarily conform to the principles of neoclassical economics that underpin welfare economics generally, and BCA specifically. For example, an estimation of the opportunity cost of volunteer time depends on whether volunteers treat time as a standard economic good or as a "conscience good" that they feel morally obligated to provide (Freeman, 1997). Another behavior of particular importance is addiction. Should consumption that satisfies addiction be treated the same way as consumption that contributes to utility under the assumption positive marginal utility? The correct application of BCA to policies that affect substance abuse often requires an answer, or plausible range of answers, to this question.

In contrast to many other policy areas, concerns about equity legitimately motivate the adoption of many social policies. Standard BCA itself is based solely on the value of efficiency. However, with advances in stated preference techniques, it may be possible to elicit people's willingness-to-pay for various sorts of redistribution and therefore changes in the equality of outcomes. For example, it may be possible to estimate how much the population would be willing to pay to move a child or family above the poverty line. Equity effects valued in this way may be included in BCA through a broader definition of efficiency, such as the one used in the application of BCA to environmental policies, that includes not only people's willingness to pay for the consumption (use) of private goods, but also their willingness to pay for consumption (nonuse) of public goods, including more equitable redistributions. This approach is not common in social policy, partly because there are not yet good shadow price estimates of these external effects (but see, for example, Blomquist et al., 2009). Consequently, BCA analysts may want to embed their standard analyses within a multi-goal framework that takes account of equity as a second value. The consideration of equity may involve a tradeoff between these two values. However, there may be some fortuitous situations in which well-targeted social policies increase both efficiency and equity.

The primary general guidelines for the conduct of BCA, the Office of Management and Budget Circulars A-4 and A-94 in the United States and the Treasury's *Green Book: Appraisal and Evaluation in Central Government* in the United Kingdom, do not provide much guidance that is specific to social policy. The most substantively relevant, but limited, guidance we were able to identify is the *Cost Benefit Framework* developed by the Department for Work and Pensions in the United Kingdom (Greenberg and Knight, 2007). Consequently, *more explicit guidance is needed to facilitate the appropriate application of BCA to*

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

social policy. In particular, research that explicitly considers the special attributes of social policy is needed to develop more confident guidelines that could eventually become standards.

THE NEED FOR A COMPREHENSIVE ACCOUNTING STANCE

Of course, all BCA should strive for comprehensiveness. Yet, in order to be comprehensive, analysts need theoretically and empirically grounded estimates of all significant impacts. In practice, the constraints of time and data prevent analysts from developing their own empirically supported estimates of shadow prices for valuing the multiple effects of most policies. They must almost always draw on estimates of shadow prices from other sources. This is, of course, impossible if nobody has developed these shadow prices! Seeking to achieve comprehensiveness is especially important in many areas of social policy because of the likelihood that policy interventions produce significant impacts beyond those often thought of as "primary." For example, early childhood interventions may produce the primary intended impact of increased cognitive development as well as later gains in schooling and employment that reduce criminal behavior. Just valuing cognitive development would substantially distort the measurement of net benefits.

Inevitably, the admonition to be comprehensive in the inclusion of valued effects in BCA will remain little more than aspiration unless the community of researchers invests in the development of commonly used shadow prices. It is straightforward to summarize our overall conclusion that guidelines or standards for those applying BCA to social programs should be bolstered with research to increase confidence in existing shadow prices and develop estimates of a number of additional shadow prices that are currently unavailable. Yet, what specifically should be the priorities? In the discussion that follows, we consider a number of issues relating to the required shadow prices. First, some shadow prices are of such importance that continued efforts to improve their estimates are needed (crime, marginal excess tax burden). Second, we identify important shadow prices that require research efforts because they are largely missing (increments of cognitive development, schooling quantity and quality), and shadow prices that require conceptual clarifications to facilitate the development of estimates (volunteer time and addiction). Third, we note available shadow prices that should be but are not routinely used (marginal excess tax burden).

The Social Benefits of Avoided Crime

Many social policy interventions affect the incidence of crime (Butts and Roman, 2009; Roman and Visher, 2009). Indeed, crime reduction is one of the primary

DOI: 10.2202/2152-2812.1013

impacts in policy areas such as juvenile justice and prisoner reentry. Additionally, taking an appropriately long-term perspective, crime reduction may also be an important benefit category in early childhood development programs and substance abuse treatment. The incidence of crime may also be affected and (ideally) reduced to some small degree by interventions in almost all areas of social policy, such as mental health and primary and secondary education. Thus, it is useful to have accurate and current estimates of the cost of crime because avoided crimes are an important source of benefits. The development of appropriate shadow prices for crimes that take account of their full social costs are thus extremely important for promoting good social-policy BCA. Like Gaul, the costs of crime can be divided into three parts: tangible costs to victims, intangible costs to victims, and criminal justice system costs. Weimer and Vining (2009) argue that there is a clear need for improvement of all three parts—better shadow prices for both tangible and intangible victim costs and better and state-specific estimates of criminal justice system costs.

Currently, the primary source for estimates of the costs of crime that are used in BCAs is Miller, Cohen, and Wiersema (1996). Miller, Cohen and Wiersema (MCW) have estimated the costs of fatal crimes (rape, assault, arson, driving while intoxicated), child abuse (sexual, physical, emotional), non-fatal rape and sexual assault, assault or attempted assault (with and without injury), robbery or attempted robbery (with and without injury), drunk driving (with and without injury), arson (with and without injury), larceny or attempted larceny, burglary or attempted burglary, and motor vehicle or attempted motor vehicle theft. MCW's estimates of the private monetized costs of these crimes included property damage and loss, the costs of medical care and mental health care, the cost of police and fire services, the cost of victim services, and productivity losses. Their estimates of intangible costs were based on estimates of the average value of life revealed by people's willingness to bear mortality risks. Following Cohen (1988), estimates of the costs of pain, suffering, fear, and lost quality of life were based on jury awards. Despite the reliance on jury awards, which do not necessarily reflect people's willingness to pay to avoid such harms, MCW's effort is an important contribution to the promotion of comprehensiveness in social policy BCA. Miller and Cohen (1997) also provide useful estimates of the victim cost of intentional gunshots and stabs. However, alternative estimation methods, including contingent valuation (CV) surveys to estimate willingness to pay for crime reductions (Ludwig and Cook, 2001; Cohen et al., 2004) and estimates of the capitalization of crime risk into housing prices (Lynch and Rasmussen, 2001), suggest that the intangible costs may be much larger than suggested by the MCW approach. For example, Cohen and colleagues (2004) find intangible costs for assaults to be about twice as large and those for armed robbery to be between five

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

and ten times as large as MCW. In view of the various validity threats to contingent valuation, replications of these studies would be valuable.

Despite these commendable efforts, much more needs to be done. By these authors' own admission, these estimates of the victim costs of crime (and therefore the benefits of avoided crime) are not comprehensive and are best thought of as lower bound estimates. Additionally, the current research only covers a subset of all crimes. *Comprehensive and current cost estimates are needed for both tangible and intangible victim costs of all types of crime*.

The third crime cost category of importance is the marginal cost of criminal justice resources. For any given social policy intervention, these "costs" could be useful for estimating either net costs or benefits. Hereafter, our parlance assumes system cost reduction. This is normally the most reasonable assumption, but ultimately it is an empirical question. System cost is an important category because reductions in crime not only benefit those who would otherwise be victimized, but also society more broadly through the reduction of real resources devoted to the criminal justice system.

Ideally, we wish to estimate these benefits in terms of avoided *marginal* costs. However, the estimation of marginal cost changes is complicated, especially for correctional resources. The most common approach to estimating the criminal justice system benefits of an avoided crime is to estimate the time savings to various criminal justice system employees, typically including police, public defenders, prosecutors, judges, court staff, and probation officers, and valuing these time savings at the employees' hourly wages and benefits. One problem with this approach is that criminal justice agencies are not necessarily equating marginal cost to marginal benefit in their application of labor and other resources. The expenditure of additional employee hours could produce marginal benefits in terms of crime reduction and justice that were either smaller or larger than the full wage rate. For example, adding the time of an additional police officer might very well reduce crime costs to victims by more than the wages and benefits of that officer. Further, an exclusive focus on employee costs may result in an underestimation of marginal cost because non-employees, victims, witnesses, jurors, and innocent defendants also bear time costs in the operation of the criminal justice system.

Estimating the marginal cost of incarceration in jails, prisons, and other correctional facilities poses the most serious challenge to measuring criminal justice system marginal costs. These sorts of facilities often require large capital costs that, although sunk for any existing facility, would have to be expended if the inmate population grew sufficiently to require new construction. Average operating costs that include wages and benefits of security personnel, maintenance, and hotel services (food service and laundry), rehabilitation, and medical care almost certainly overestimate the marginal cost of adding an

DOI: 10.2202/2152-2812.1013

additional inmate to the facility in the absence of overcrowding. (The addition of another inmate to an already overcrowded facility could conceivably result in marginal costs larger than the average operating cost if it increases violence among prisoners or against prison personnel.)

Incarceration within existing arrangements may involve large externality costs. Approximately a quarter of the HIV population in the United States, and an even higher fraction with hepatitis C, pass through correctional facilities within any given year (Hammett, Harmon, and Rhodes, 2002). These inmates have the potential to spread these infections to other inmates while incarcerated, and to members of the community after release. Such external costs are potentially very large. Inmates may also impose external costs on their families, especially if their incarceration necessitates foster care of dependent children. The list of tangible and intangible externalities that could arise from incarceration is potentially long. These few sentences hardly do justice to them. Rather, they make clear that considerable analytical effort is required to assess the marginal costs of incarceration.

The standing issue may also arise in assessing the marginal costs of jails or correctional services provided on a for-fee basis to local jurisdictions. Often these charges are based on budgetary expenditures and do not correspond to marginal costs. For example, the fees for correctional services provided to counties for juveniles may be based on the average costs of operation (Engle and Weimer, 2005). It is unclear whether these average costs approximate the long-run marginal costs.

Better estimates of the marginal costs of criminal justice system resources, especially the marginal costs of incarceration, including marginal external costs, would improve the comprehensiveness of BCAs in the many social policy areas that affect crime. Practical guidelines that analysts could apply in moving from available budgetary and average operating cost data in specific states or locales to appropriate shadow prices would also be useful.

Productivity Benefits

Most investments in human capital aim to increase the labor productivity of the target population in some way. This is a direct benefit of interventions that improve productivity. Additionally, this increased productivity may induce further indirect benefits, such as improvements in the health, self-esteem, and happiness of participants (i.e. their consumer surplus) and the welfare of participants' children. Even more indirectly, there might also be reduced administrative costs in those agencies that administer income transfer programs. These indirect effects are also real benefits or costs, albeit they are much more difficult to measure; indeed, they are almost always not measured (Greenberg and

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

Knight, 2007). For suggestive studies on how some of these impacts might be measured and included in BCAs, see Grogger, Karoly, and Klerman (2002) and Morris (2001).

The usual procedure employed by labor economists for measuring the direct productivity gains focuses on measuring the resulting increases in wages, rather than increases in hours worked. This follows the reasoning that, at the margin, the value of the lost leisure from additional hours of work equals the full wage rate: the gain to society from the added production is fully offset by the loss to the worker providing it. In other words, additional hours worked are a transfer from the worker to society; there is no net gain in social benefits. However, BCA analysts generally make the case that the equality is actually between the value of lost leisure and the *after tax* wage rate, and consequently they argue that the tax revenue resulting from additional hours worked should be counted as an external benefit—this portion of the additional production is gained by the rest of society and is not offset by the worker's loss of leisure. There is, therefore, a net social gain.

A slightly more sophisticated argument suggests that workers most likely have upward sloping supply schedules that indicate their marginal opportunity costs at various levels of hours worked (Greenberg and Robbins, 2008). Programs that increase hours worked at the same wage rate may yield net productivity gains on the additional infra-marginal units.

The usual procedure for measuring productivity gains can be readily monetized: the productivity benefit accruing to the worker is the increase in income due to higher wages, and the external productivity benefit is the additional wage taxes paid. The more sophisticated treatment, however, requires an estimate of the worker's elasticity of supply of labor. However, either procedure is implicitly based on the (strong) assumption that labor markets are perfectly competitive, such that all workers are able to smoothly adjust the hours they work in response to changes in wage rates. Many characteristics of real-world labor markets, such as involuntary unemployment or underemployment, removal from the labor market due to mortality, and work absences due to morbidity render this assumption unrealistic. This, in turn, raises questions about the proper approach for measuring productivity changes resulting from social policies.

The labor market access issue is likely to be particularly central to mental health and prisoner reentry interventions. For example, people with mental illnesses may be unable to satisfy the requirements of normal labor market participation (Baron and Salzer, 2002). Interventions that allow those with significant mental illnesses to gain employment may provide benefits that exceed an estimate obtained from the difference between total after-tax wages and the total opportunity cost of supply as measured using a typical labor-supply schedule. Indeed, Weisbrod (1981) reached this conclusion in his BCA of a

DOI: 10.2202/2152-2812.1013

comprehensive community treatment program. Consequently, Weisbrod estimated productivity benefits as equaling the total increases in earnings.

Researchers in health policy have extensively debated the appropriate treatment of lost labor due to morbidity or mortality (Olsen, 1994; Weinstein et al., 1997; Olsen and Richardson, 1999). The standard approach is to treat absences from work due to illness as costing society an amount equal to the missed hours times the full wage rate (even though this assumes that an individual receives no surplus from this time off work). Nicholson et al. (2006), however, find that, because of team production, absences may involve social costs that exceed the value of the lost labor of the absent worker. They provide estimates of these external costs for 35 job types, reporting a median multiplier of 1.28.

The direct productivity costs of mortality, or other involuntary labor market exit, have generally been treated as included in the value of quality-adjusted life years. Assuming the availability of replacement workers, the external costs of involuntary exit from the labor market have been assumed to equal the costs firms incur to replace the lost worker.

In view of the central importance of productivity as a benefit category in almost all areas of social policy, *comprehensive and consistent standards for the measurement of the effects of interventions that increase human capital or affect the use of human capital would help improve BCA and contribute to comparability across BCAs*. *More empirical work to develop rules-of-thumb for productivity-related parameters such as non-wage benefits and tax rates, the externalities of network production in various categories of employment, the replacement costs of workers, and the decay rate for induced productivity gains would also be extremely useful*.

Opportunity Cost of Public Expenditures: Marginal Excess Tax Burden

It is common practice in applied BCA not to include the opportunity cost of government expenditures. However, most social policy interventions do, and would, require net public expenditures, at least in the short run: one way or another, whether currently or in the future, these expenditures must be funded by taxation. The ratio of these additional costs of taxation to the amount of revenue collected is the marginal excess tax burden (METB) of the taxation. Each dollar of expenditure funded by tax revenue costs society (1+METB) dollars in real resources. Conservative estimates, for example, suggest that the U.S. METB appears to be on the order of 10 percent for excise taxes (on goods other than alcohol, tobacco, and gasoline) and about 30 percent for income taxes (Ballard et al., 1985). However, Feldstein (1997, 1999) has argued that these estimates are lower bounds for the METB for several reasons, including the fact that they do not include the effect of tax avoidance on labor supply. Boardman et al. (2006,

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

429) suggest that for most BCA purposes the appropriate METB is closer to 40 percent (see also Gruber and Saez, 2002). The implication of not using the METB is that the conventionally described net benefits of interventions involving an excess of government expenditures over revenues will be too large, while those for interventions involving an excess of government revenue over expenditures will be too small.

The preponderance of positive net benefits found in published BCAs does suggest that quite a few proposed social policy interventions would still show positive net benefits if the appropriate opportunity cost of public funds were included. Yet, from a comprehensiveness perspective, this does not excuse the exclusion of these costs, especially as the pursuit of all apparently cost-beneficial interventions would require much larger budgets and the greater taxation required to fund them.

What is the source of the opportunity cost of public funds? There are two reasons why raising one dollar of revenue from taxes typically costs society more than one dollar of resources. First, a tax creates inefficiency, or deadweight loss, that results from taxpayers' responses to the tax. For example, income taxes induce taxpayers to work less or take other actions to reduce their tax payments. These actions involve real social costs, whether in terms of forgone production or consumption. There are, of course, some well-defined exceptions to this rule, such as an excise tax on a good that produces a negative externality. Second, the collection of taxes requires the use of real resources that have an opportunity cost.

It is common in BCA practice to treat a dollar raised by a government tax and transferred to an individual as a one-dollar cost to government that is exactly offset by a one-dollar benefit to the recipient. The correct opportunity cost perspective, however, is that the transfer would result in a net cost of METB dollars. As we have emphasized, the METB is rarely included in actual BCAs. Indeed, Weimer and Vining (2009) found no examples of its use in the published BCAs in the social policy areas they reviewed and only a few examples of its use in government-sponsored reports (e.g., Greenberg and Davis, 2007). Although we have been hesitant to go beyond a guideline level for most of our prescriptions, we think this can be elevated to a standard: *an estimate of the marginal excess tax burden should be included in social policy BCAs*. However, this elevation also requires that research efforts be directed at updating and improving this important shadow price.

Better Measures of the Benefits of Further Schooling

A variety of social policy interventions may affect the quantity and quality of schooling. Most obviously, education-based interventions are designed to increase the number of years of schooling and completion of degrees. So too do

interventions in the areas of early childhood development, juvenile justice, mental and physical health, and substance abuse. For example, a preschool program may increase the number of years a child voluntarily stays in school. Thus, increasing the number of years of schooling or the completion of degrees are important sources of benefits in several social policy areas. We have emphasized increments of school quantity because there is less prima facie evidence that increasing the "quality" of schooling (at least in developed countries) produces incremental benefits. The important caveat to this conclusion is that classroom, school, or school district quality is a multi-dimensional concept. It is possible that most empirical studies of quality have been looking for it in the wrong places (standard school *inputs*, such as teacher/student ratios, appear to be one of the clearly wrong places.) The right places appear to be school attributes that raise cognitive skills (Hanushek and Woessmann, 2008). While it is certainly possible to treat any benefits arising from schooling increments as simply one form of productivity enhancement, there are sufficient differentiating characteristics to treat it separately.

Economists have provided estimates of the productivity gains from greater quantity (and, to some extent, quality) of schooling as measured in terms of the impact on higher earnings and non-wage labor market remuneration (Card, 2001). The contribution of increments of schooling to earnings appears to be highly robust (Harmon, Oosterbeek, and Walker, 2003; Heckman, Lochner, and Todd, 2006; Oreopoulos, 2006). However, schooling may have other benefits. Some of these benefits, such as improved health, accrue directly to the schooled persons (Grossman, 2006). Their families may benefit from improved consumption efficiency and effectiveness in choosing the desired number of children. Children benefit in terms of cognitive development, health, and schooling success, and these benefits may carry over to some extent to successive generations. Communities enjoy some external benefits, such as reductions in crime.

Haveman and Wolfe (1984) have set out the standard framework for valuing many of these effects using a household utility function in which schooling is one of the inputs. Haveman and Wolfe were able to extract shadow prices for schooling in the production of outputs as a function of the marginal productivity of other inputs, such as family income. The total non-productivity benefit of schooling could then be estimated by summing across the various outputs other than productivity to which it contributes. Based on the then available studies, they estimated that the non-productivity benefits of schooling were comparable to the commonly measured productivity benefits. Thus, their estimates suggest that in BCA the appropriate shadow price for a year of schooling is roughly double the estimated productivity benefit.

Wolfe and Haveman (2001) updated their 1984 review with more recent empirical evidence concerning the non-productivity benefits of schooling, and

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

they also expanded the categories of benefits. For example, studies indicate that parental education not only affects their fertility choices, but also affects the probability that their teenage daughters will give birth out of wedlock (Hayward, Grady, and Billy, 1992; Lam and Duryea, 1999). Although they do not provide monetary estimates, they conclude that their earlier finding of approximately equal magnitudes for the labor and non-labor market benefits of schooling most likely still holds. Davies (2003) reviews the empirical macroeconomic literature and concludes that there are likely additional external benefits of education that go beyond those considered by Wolfe and Haveman. Dee (2004) finds that education contributes to voter participation and support for free speech, suggesting the possibility of eventually monetizing the "civic return" to education (see also Milligan, Moretti, and Oreopoulos, 2004; and Blomquist et al., 2009).

A consensus range of shadow prices for further schooling would be an extremely valuable contribution to improving CBA. As much of the non-labor market benefit arises through the increased earnings that result from schooling, *a practical rule of thumb for scaling up productivity gains measured in markets to the full social benefits would also be valuable.* Although such a rule of thumb would not necessarily incorporate all the benefits of schooling, it would not become obsolete as estimates of the benefits of productivity gains changed over time.

Better Measures of the Benefits from Cognitive Development

A number of social policy interventions, such as prenatal, nutritional, and early education interventions, have the potential to improve the cognitive development of children. Indeed, preschool investments that improve the cognitive development of disadvantaged children may offer higher rates of return than any schooling improvements and job training programs provided later in their lives (Heckman, 2006). The cognitive benefits are most easily conceptualized, and measured, in terms of IQ improvements, although it can also be derived from measures of change on basic skills assessment tests, including those for math, science, and reading (Hanushek and Woessmann, 2008). Improvements in cognitive development or cognitive skills, in turn, contribute to other desirable, but more indirect, participant outcomes. The most obvious contributions are to educational inputs or outputs: increased school readiness, which reduces grade retention and the need for special education; higher achievement within school; more years of schooling completed; and higher graduation rates. It may raise the happiness and self-esteem of participants. It may also contribute to better social skills that reduce costs that are largely external to participants, such as delinquent and criminal behavior, teen pregnancy, and substance abuse. Other external benefits from improved cognitive development might include more civic-minded

DOI: 10.2202/2152-2812.1013

behavior. Obviously, some of the issues discussed in this section overlap with those discussed under the benefits of further schooling.

BCA of interventions that affect childhood development interventions would ideally take account of all these possible impacts. The rare long-term longitudinal studies, such as those of Perry Preschool or the Abecedarian Project, measure many of the impacts that may result from improved IQ (Wolfe and Tefft, 2009). Although there may be a small residual effect of IQ gain that is not captured in these studies, it is likely to be relatively small, especially as IQ gains appear to be less likely to persist over time than scholastic success (Currie, 2001).

How might the shadow price of this benefit be refined? Weimer and Vining (2009) argue that a plausible starting point would be analyses of data from existing longitudinal studies to relate short-term IQ gains to longer-term outcomes. The shadow prices of schooling discussed in the previous section could be used to link the IQ gains to monetized outcomes through schooling. That is, IQ gains would be related to schooling gains, which in turn would be shadow priced to take account of their productivity and non-productivity benefits. There would also be potential gains in terms of fewer grade repeats and less need for special education that would not be captured in the shadow prices for schooling. Any additional impacts of IQ gain that can be identified should also be monetized and included in the IQ shadow price. The long chains of inference that are required might very well yield such a wide range of values for the shadow price that it would be of little value. Nonetheless, *having at least some idea of the value of IQ gains would be useful in BCA if for no other purpose than assessing whether such gains could potentially be large enough to affect the sign of net benefits*.

Better Estimates of, and Consistent Use of, the Opportunity Cost of Volunteer Time

At first view, the appropriate treatment of the opportunity cost of volunteer time appears conceptually straightforward. The two leading sources of economic evaluation guidelines in health policy, for example, argue that this opportunity cost should be included in program cost (Gold et al., 1996; Drummond et al., 2005). That is, it is normally argued that volunteers' time has some positive opportunity cost, whether it be in leisure or labor. However, a recent review of reviews of health-policy costing studies found that almost no studies actually included volunteer time as a program cost (Adam, Evans, and Koopmanschap, 2003). Even when analysts are prepared to include this cost, they face the practical difficulty of choosing a shadow price based on the value of the services being provided or the value of the time of the donor. In practice, those analysts

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

that have included this cost have skirted detailed consideration of this issue by simply shadow pricing as some fraction of the median wage in the local market.

Nonetheless, implementing a more refined shadow price requires addressing a fundamental question: Why would someone who has skills highly valued in the marketplace volunteer to do much lower-skilled labor? A guiding principle of welfare economics is that revealed preferences should be taken at their face value unless there is a good reason to do otherwise. The recognition of this principle suggests that volunteers realize utility from the activity at least as large as their opportunity costs of time; otherwise they would not be volunteering! From this perspective the shadow price of volunteer time may reasonably be treated as zero—the opportunity cost of the time is fully offset by the benefit realized by the volunteer. Indeed, if volunteers derive significant utility from volunteering, it would make sense to treat this value as a benefit of an intervention. In contrast, the treatment of volunteering as a conscience good, something that many donors feel morally obliged to provide when asked, casts doubt on the argument that the benefits of volunteering exceed the opportunity costs (Freeman, 1997). Because conscience goods are provided as a perceived duty rather than as a weighing of economic choices, donors might very well assess their own welfares as being worse for having provided the goods than if they had not been asked to do so.

Mukamel, Gold, and Bennett (2001) explicitly incorporated the revealed preference argument for sensitivity analysis purposes and therefore shadow priced volunteer time at both the wage rate and zero. The shadow pricing of volunteer time can be substantively important. For example, a study of Big Brother/Big Sister programs by Aos et al. (2004) reported benefit-cost ratios of over three when volunteer time was shadow priced at zero, but very close to one when volunteer time was shadow priced at the wage rate.

However volunteer time itself is treated, it is clear that organizations making use of volunteer time bear the costs of recruiting, training, and monitoring volunteers. These costs should be included in the shadow price of volunteer time. Further, there may be externalities involved in these functions. An organization that provides poor experiences for volunteers may depress the total supply of volunteers in the community. Wasting volunteers' time or assigning volunteers tasks that members of the organization see as undesirable or low priority may encourage some volunteers to withdraw their contributions of time.

Having a greater consensus on the proper method for valuing volunteer time strikes us as important, especially when comparing faith-based and other privately delivered social services to those delivered by government agencies. *More sophisticated guidelines that take account of the nature of the volunteering would be valuable to analysts*. *The minimum standard for the treatment of*

DOI: 10.2202/2152-2812.1013

volunteer time would be sensitivity analysis that includes the boundary values of zero and the wage rate.

Plausible Estimates of the Social Costs of Substance Abuse

An important feature of the recent growth in BCA has been its wider application to substance abuse policy (e.g., Egerton, Fox, and Leshner, 1997; Cartwright, 1998; Cartwright, 2000; French et al., 2002). However, most evaluations of drug prevention or treatment interventions have short follow-up periods even though the participants involved in the interventions might well experience long-term behavioral changes. Therefore, the current evaluations often provide limited opportunity to observe directly socially relevant behaviors that relate to the social costs of drug consumption. This problem is particularly serious because intervention effects may be highly nonlinear with time. Reductions in consumption might accelerate with time as a result of a "virtuous cycle" or decay increasingly quickly. Therefore, the application of BCA to these interventions through direct shadow pricing of all major effects is either impractical or highly speculative. Most evaluations can provide plausible estimates of reductions in drug consumption of effective interventions during the program participation period and the (typically short) follow-up period. Consequently, most economic analyses in what can be broadly defined as substance abuse policy are actually cost-effectiveness analyses that estimate cost per unit of reduction in substance consumption. So, at a minimum, robust shadow prices for reductions in the consumption of specific illicit drugs would make it more feasible to assess and compare programs using BCA, primarily by allowing researchers to monetize drug reduction effects in the numerous existing cost-effectiveness analyses.

To the extent that these shadow prices reflect streams of future costs and benefits, they would allow analysts to convert the short-run impacts measured in most program evaluations to more appropriate measures of social costs and benefits. Ideally, such shadow prices would be developed based on long-term experiments designed specifically to estimate future effects. In practice, rough estimates of these shadow prices may be developed from the body of evidence from observational studies linking changes in substance abuse to future labor market and other impacts.

A number of studies have estimated the social costs of drug use. For example, Harwood, Fountain, and Livermore (1999) provide estimates of the health, productivity, crime, and other social costs of alcohol and illicit drug abuse. Using these estimates, as well as other sources of information such as school-based treatment evaluations, drug use surveys and various literatures, Caulkins et al. (2002) estimate the average social cost per unit of marijuana consumption and cocaine consumption. Moore (2007) estimates the social costs in terms of health

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

and crime effects in Australia per gram for cannabis, cocaine, opiates, and amphetamines. He also estimates the annual social costs for dependent and non-dependent users of these substances. Caulkins (2009) argues that it is particularly important to develop further estimates of the social costs of stimulants (cocaine and crack) and amphetamines, as these probably generate approximately three-quarters of the social costs of illicit drug use in the United States.

In view of the magnitude of the social costs of drug consumption, much more research is needed to develop shadow prices for both legal and illicit drug consumption based on marginal social costs. To be practically useful, these estimates should be disaggregated by type of consumer, most critically by non-addicted versus addicted (see addiction below) but also by demographic groups such as age and sex.

Estimating the costs associated with consumer use, though, raises a major conceptual issue with respect to the social costs of price changes of addictive goods. In BCA, the standard approach to valuation assumes fully rational consumers. In such cases, increases (decreases) in the prices of these goods would result in social surplus losses (gains) for consumers of the good (Weimer, Vining, and Thomas, 2009). In many areas of drug policy, however, perhaps because of implicit unease with the standard BCA approach, the practice is to ignore social surplus changes to consumers (Ettner et al., 2006; French et al., 2002).

Relatively little attention has been given to the important questions surrounding this issue with the exception of the Australian Productivity Commission (1999) and Laux (2000). What should be the correct approach? How can the correct approach be implemented? Even more controversially, should any alterations to standard practice be extended to psychological or socio-psychological addiction? The Australian Productivity Commission (1999), for example, has argued that gambling can be addictive. The Commission argues that approximately 2 percent of Australian gamblers should be considered to be addicted. Although a small percentage, the commission argues that the social costs arising from gambling by these problem gamblers could offset all the consumer surplus gains of recreational ("non-addicted") gamblers. Other recent studies suggest somewhat higher percentages of pathological gambling that is essentially equivalent to addicted behavior (Potenza, Kosten, and Rounsaville, 2001; Narayanan and Manchanda, 2008). There also appear to be systematic interactions between gambling and, at least, nicotine addiction (Grant, Rani, and Potenza, 2009). Because of the importance of this question, we devote a subsequent section of this report to the BCA treatment of social surplus in social policy relating to addiction.

Is it important to distinguish between legal or illegal (i.e., illicit) drugs in assessing the social costs of drug abuse? There might be a case for doing so if

DOI: 10.2202/2152-2812.1013

one could reasonably conclude that legal status was based on some coherent assessment of social cost. However, the evidence suggests that this is not the case, perhaps because historically much drug policy was formulated before the pharmacological and genetic bases of addiction were clearly understood and appreciated. The nicotine in tobacco, a legal substance, is now recognized as one of the most addictive substances known to science (Hogg and Bertrand, 2004; Tapper et al., 2004). This suggests that legal status should be considered a policy choice (see MacCoun, Reuter, and Schelling, 1996, for a fuller exposition of this argument). If this were not the case, then many alternatives that might pass the net benefits test would be eliminated from analysis.

DEALING WITH HEIGHTENED UNCERTAINTY IN SOCIAL POLICY ARENAS

The application of BCA to social policies typically involves producing predictions of net benefits based on imprecise predictions of numerous effects and their monetization with relatively uncertain shadow prices. Effectively, net benefits are the sums of products of random variables. Predicting net benefits using mean values for the random variables does not necessarily produce a good prediction of the mean of net benefits, the common metric for assessing efficiency. A much more appropriate approach is to treat the uncertainty in the predictions of effects and their shadow prices explicitly through Monte Carlo simulation. However, Monte Carlo simulation is thus far not standard practice in the application of BCA to social policy. In view of the multiple uncertain effects contributing to predictions of net benefits in most social policy applications, *Monte Carlo simulation should be the standard basis for assessing net benefits in social policy*.

The application of Monte Carlo simulation in BCA is conceptually straightforward. First, probability distributions for each parameter (predicted effect or shadow price) are specified. These distributions may involve covariance among parameters, for example when several coefficients and their variance-covariance matrix specify the multivariate t-distribution for several BCA parameters. Often the distributions themselves are highly uncertain and modeled as uniform distributions over some plausible range. Second, a trial is conducted in which a specific parameter value is drawn from each distribution and used to calculate a corresponding net benefit. Third, a large number, typically in the thousands, of trials are conducted to produce a distribution of net benefits, which can be displayed as a histogram. Fourth, summary statistics are computed for the distribution of net benefits. The "point prediction" of net benefits would typically be the mean net benefits across trials, which may differ from the net benefit predicted based on a calculation using the mean values of all parameters. (In applications where the mean may be overly influenced by a small number of trials

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

with large net benefits, the analyst may choose the median of the distribution as the point prediction of net benefits.) The spread of the distribution, measured as a standard error, can also be readily calculated. For examples of well-developed Monte Carlo simulations in the BCA context, see Weimer and Sager (2009) and Nicol (2001).

BCA analysts usually do not explicitly frame BCA as testing the hypothesis that net benefits are positive. However, if the hypothesis of positive net benefits is viewed as the central concern of BCA, then the fraction of Monte Carlo trials with positive net benefits can be interpreted as a test of the null hypothesis of zero net benefits. If the fraction of trials with zero or negative net benefits is very small, then one can confidently reject the null hypothesis in favor of the alternative of positive net benefits.

Focusing on the hypothesis of positive net benefits differs from the statistical inference approach commonly employed in social science research. Particularly in the case of estimating parameters from a single study, whether experimental or observational, the common social science approach would be to treat parameter estimates that do not achieve conventional levels of statistical significance as "zero" to guard against Type I error. Nonetheless, under standard statistical assumptions, the estimated coefficient is the best estimate (in terms of mean square error) of the parameter even if it is not statistically significant at conventional levels. Returning to the importance of comprehensiveness in BCA of social policies, it is more appropriate to use the estimated but statistically insignificant coefficient, rather than zero, as the parameter value in calculating net benefits. However, incorporating the imprecision of the estimate in the predicted distribution of net benefits is all the more important. Hence, Monte Carlo simulation, or some other explicit accounting of uncertainty, is necessary.

Note that focusing on the hypothesis of positive net benefits avoids the necessity for addressing the issue of multiple comparisons. Analysts concerned about the statistical significance in the context of estimating many effects from the same experiment or observational study often make adjustments to statistical tests or p-values to take account of the fact that, while any particular test may limit the probability of falsely rejecting the null hypothesis to the stated p-value, the probability of having false rejections rises above the p-value in each individual test for the collection of tests——see, for example, Perneger (1998) and Anderson (2008). This adjustment process, while preserving the overall p-value for a false rejection to some level, typically results in some parameters being judged as statistically insignificantly different from zero despite their individual tests showing significance. From a BCA perspective, this aggravates the problem of treating statistically insignificant parameters as zero, making focusing on the hypothesis of positive net benefits even more important.

DOI: 10.2202/2152-2812.1013

In terms of communicating the uncertainty of estimates to decision makers, reporting the fraction of trials with positive net benefits along with the mean net benefits may be particularly effective. Specifically, the "probability of positive net benefits" as estimated from the fraction of trials with positive net benefits is likely to be more meaningful to a decision maker than, say, "the standard error of the distribution of outcomes." The results from assessing multiple alternatives may be presented in a diagram like that shown in Figure 1, which shares with cost-effectiveness acceptability curves the use of Monte Carlo simulation to estimate the probability of finding positive net benefits (Fenwick et al., 2001). The points represent various combinations of mean net values and probabilities of positive results. The line segments show the alternatives that are not dominated by any other alternatives in the sense that none of the other alternatives offer increases in either dimension without decreases in the other. The line segments can thus be thought of as forming a production possibility frontier for tradeoffs between mean net benefits and probability of positive net benefits. Although BCA under the assumption of risk neutrality provides no basis for choosing among policies with the same mean net benefits, decision makers who are risk averse would certainly prefer less risky policies with the same mean net benefits. More generally, decision makers who are risk averse would prefer policies somewhere on the frontier in Figure 1. Their particular choices would depend on how they trade off mean net benefits with probability of positive net benefits. If these preferences were represented in indifference curves, then they would each choose the policy that allowed them to reach the indifference curve giving them the highest utility. That is, the one furthest to the northeast.

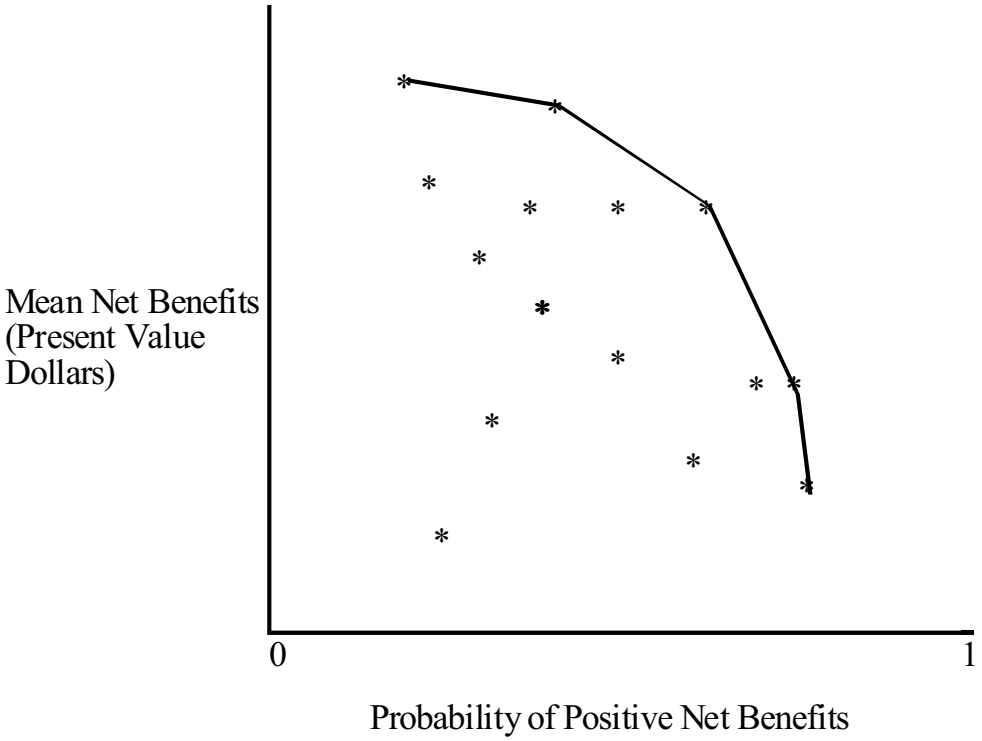
The use of parameter distributions taken from empirical estimates of parameters should be viewed as the starting point for Monte Carlo simulations for two reasons: the danger of regression to the mean and optimism bias.

Statisticians recognize the implications of the difference between estimation and prediction (Copas, 1997). Social scientists most often focus on estimation, relying on the statistical properties of estimators. However, analysts conducting ex ante BCA are generally not concerned about the value of a parameter as estimated with respect to a particular set of data, but rather using the estimate as a basis for prediction of the parameter for assessing a policy that has not yet been adopted. Beginning with Stein's paradox (Effron and Morris, 1997), statisticians have recognized that regression to the mean implies that the best estimates are not the best predictions. Typically, estimates tend to be predictions that are too large in absolute value terms. Consequently, it is desirable that analysts adjust estimates downward in making predictions, especially when the estimates come from a single study——estimates from meta analyses are less prone to the problem because it is less likely that multiple studies would all

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

produce extreme estimates. *Providing a systematic basis for making such adjustments should be a research priority for the BCA community*.

Figure 1
Frontier of Mean Net Benefits and Probability of Positive Net Benefits



Individuals may exhibit cognitive biases that make them overly optimistic about the potential for policies that they develop or advocate. The UK Green Book explicitly warns against the danger of optimism bias, especially in the context of large and complex projects (HM Treasury, 2009: 86). Drawing on research suggesting that programs closely controlled by developers or researchers systematically show better results than programs in "real world" administrative settings, analysts at the Washington State Institute for Public Policy routinely discount effects from studies not in "real world" settings by 50 percent in their meta-analyses (Drake, Aos, and Miller, 2009: 178). *Developing guidelines for guarding against optimism bias would contribute to more effective BCA of social programs*. Although there have been some studies comparing ex ante BCA estimates with ex post assessments (see, for example, Boardman, Mallery, and

DOI: 10.2202/2152-2812.1013

Vining, 1994; Anguera, 2006), more such studies are needed to provide a better empirical basis for assessing the risks of optimism bias.

IMPORTANCE OF EQUITY IN SOCIAL POLICY

BCA is a protocol for assessing efficiency. Many social programs, however, also have equity goals. Indeed, some programs have the explicit goal of improving the conditions of disadvantaged segments of the population, perhaps by raising their incomes or consumption of specific goods, such as food or housing, closer to the population average. Recognition of declining marginal utility opens the door for incorporating equity into BCA. Further, to the extent that people in the general population have willingness-to-pay for improving the status of the lowest income people, it is conceptually possible to employ stated preference methods to estimate this willingness-to-pay and incorporate it into BCA as an efficiency effect. When this approach is not feasible, policy analysts have no choice but to treat both equity and efficiency as distinct goals; that is, assessing efficiency through the prediction of net benefits and making explicit comparisons among alternative policies in terms of tradeoffs between the two goals. Fortunately, well-targeted social policies often do not pose stark tradeoffs.

Stretching Standard BCA: Recognizing the Declining Marginal Utility of Money

BCA takes the existing distribution of wealth as given and assesses the relative efficiency of alternative policies given that distribution. The rationale for a significant subset of social policies is that they seek to improve the conditions of disadvantaged groups in society, such as the poorly educated and unhealthy. Should BCA of these kinds of policy be adapted to take account of the social value of these improvements?

Some economists have proposed the use of BCA with distributional weights as a way to incorporate desirable distributional effects of policies (Boardman et al., 2006: Chapter 18). The normative rationale for distributional weighting is an application of the standard idea of declining marginal utility—in this case, the declining marginal utility of money. Given the differences in the level of wealth, an equal marginal increase in wealth increases the utility of poorer persons more than richer persons. An obvious problem with this approach is that, for a practical (and relatively consensual) use, ratios of marginal utilities at various levels of wealth are required. Researchers have postulated plausible proxies for relative marginal utilities based on tax rates (Eckstein, 1961; Haveman, 1965) or patterns of public expenditures (Weisbrod, 1968). Yet, in general, distributional weighting in BCA heretofore has generally been viewed by

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

economists as a supplement to, rather than replacement for, standard BCA (Harberger, 1978). However, this solution sits somewhat less easily in social policy areas than in the traditional domains of BCA.

The severity of this problem is somewhat offset by the fact that some distributional weighting is indirectly introduced in BCA through the use of average shadow prices for normal goods. For example, economists generally use a single (average) shadow price for the value of a statistical life despite the empirical evidence that willingness-to-pay for reductions of mortality risk rise with income. They also tend to use some ratio of average wage rates in determining the value (cost) of changes in waiting time. *We recommend research designed to establish a gradient giving guidance for adjusting these values depending on the characteristics of the population affected by the policy intervention.*

Willingness to Pay for Redistribution

An alternative approach to measuring the social benefits of improvements to the circumstances of the least advantaged is based on the observation that many people derive utility from helping the disadvantaged. In other words, they are willing to pay something to help the most disadvantaged. The spontaneous outpouring of charitable giving after major disasters is one indication of such altruism. Experiments that attempt to put subjects behind a "veil of ignorance" in terms of the consequences of distributive policies for their own circumstances suggest general preferences for providing everyone with at least some minimum level of income (Frohlich, Oppenheimer, and Eavey, 1987). Experiments that use the so-called "Dictator Game" also provide some indirect evidence on this question. In the dictator game, "Proposers" have a fixed sum of money that they allocate between themselves and "Responders" (i.e. potential recipients). Although responders have no way to sanction proposers if they give nothing, the experimental evidence shows that they often offer between 20 and 30 percent of the total allocation (Camerer, 1997). To the extent that these preferences, which have been referred to as "moral sentiments" (Zerbe et al., 2006), can be translated into standard willingness-to-pay measures, they can be incorporated into standard BCA. It would be valuable to have more work on this question. The starting point would be in terms of income or wealth disparities, but it is not clear that many people would not have greater preferences for redistribution if the "willingness-to-pay" question was framed in terms of other dimensions of disadvantage: for example mental or physical disability. (This could flow from a belief that these forms of disadvantage are less subject to moral hazard than, say, work effort.)

The conceptual starting point for valuing improvements in circumstances for the disadvantaged is a hypothetical (or contingent) comparison between the

DOI: 10.2202/2152-2812.1013

current situation and an alternative to it that differs only in terms of the number of people who are "disadvantaged." In terms of income or wealth disparity, for example, the alternative state of the world might be described as having one less family with an income below the poverty line. If a person were willing to pay to have the alternative over the current state of the world, then this amount would be interpreted as the person's willingness-to-pay to have one less family in poverty. This would provide a shadow price for valuing changes in the number of families in poverty resulting from alternative policy interventions.

CV surveys could provide data for estimating such shadow prices. Although critics remain, CV is now widely used and accepted; CV studies now number in the thousands (Carson, forthcoming). Its application is now widespread in health policy (Diener, O'Brien, and Gafni, 1998) and other areas of social policy. The potential application of CV to estimating willingness-to-pay for reduced poverty can be illustrated from its use in a somewhat related context: Dickie and Messman (2004) assessed parents' willingness-to-pay to relieve both their own acute illness and that of their children. They estimate that parents of three-year-olds are willing to pay about three times as much to relieve their children's symptoms as they are to relieve their own symptoms. (Perhaps not surprisingly, they also find that this ratio falls to one-to-one as the children go through their teenage years!)

Using CV to develop shadow prices for the population's altruistic value of improving the circumstances of the disadvantaged would make an important contribution to the application of BCA to social policy. As CV requires clear descriptions of the good being valued, *a relatively narrow research focus on shadow prices for moving a child, an adult, or a family above the poverty line would be a good starting point.* In view of the remaining controversy over CV in general as well as over specific methods of willingness-to-pay elicitation, it would be unrealistic to think that convincing shadow prices could be developed from a single study, or even a small number of studies.

The "Efficiency-Equity Tradeoff"

Efficiency and equity often involve a trade-off, but not always. In some situations involving market failures or the targeting of low-wealth groups with larger marginal benefits, efficient policies may involve desirable redistribution (Aghion, Caroli, and Garcia-Penalosa, 1999; Rogers, 2003). Consider a good with a positive externality, such as vaccination against a communicable disease. Increasing consumption of the vaccine by lower income families through a subsidy would both increase efficiency and provide greater income equality in preventive health care. Sometimes targeting disadvantaged groups may even lead to higher levels of efficiency than would be the case with a broadly targeted

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

intervention, because the intervention has a larger marginal effect on the disadvantaged than the general population. Such may be the case with class-size reductions, which have larger marginal effects for lower-income than higher-income families; increased access to private schooling, which may produce larger educational gains for minority than majority children; and drug treatment programs, which may produce greater reductions in external costs for lower- rather than higher-income drug abusers. These situations produce what might be called a "double dividend" because they increase both efficiency and equity.

Social policy analysts cannot assess the potential for a double dividend, however, unless they disaggregate benefits and costs by potentially relevant social or economic groups. Currently, disaggregation is most often done (Boardman et al., 2006: 302-305) or discussed (Krutilla, 2005) in terms of program participants as a group versus the rest of society or taxpayers. However, disaggregating among program participants may be possible when predictions of effects are based on experiments or quasi-experiments that allow sorting of participants by demographic characteristics.

THE SPECIAL PROBLEM OF ADDICTION

The standard assumption in applied BCA is that market demand schedules are marginal valuation schedules and therefore the appropriate basis for the measurement of benefits. However, addiction brings into question this correspondence. The addicted demand may not provide gains in utility in the same way as demand not driven by addiction. BCA that ignores the problem of addiction generally overestimates the costs of interventions that reduce consumption of the addicted good.

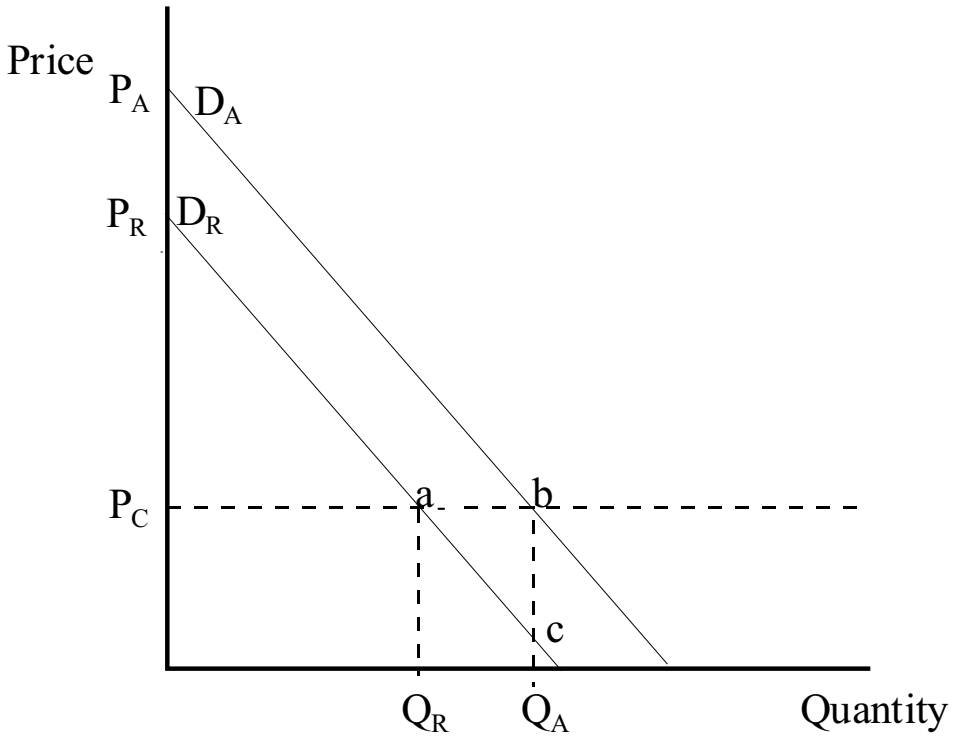
What is addiction? Clarke and Danilkina (2006: 1) provide the following working definition: "a substance is addictive if, as the duration and intensity of consumption increases, (i) the agent becomes tolerant to the substance so they progressively want more of it; (ii) the agent finds it increasingly difficult to cease consumption; (iii) if they do quit, they suffer withdrawal disutility. Finally, (iv) if use is interrupted or ceases, the agent experiences unpleasant, and perhaps long-term, cravings for the substance." With the modification that the agent may actually reach a plateau of demand for the substance, we accept this definition.

Figure 2 illustrates the addiction problem. The market demand schedule for a good is shown as D_A. It includes the demand for both addicted and non-addicted consumption. The schedule labeled D_R shows demand in the absence of addiction. For example, if D_A is the total demand for cigarettes, then D_R is the demand for cigarettes if no one were addicted to cigarettes. Suppose a policy removed this good from the market. Standard BCA would count the area of triangle P_AbP_C as the consumer surplus loss and therefore a cost of the policy.

DOI: 10.2202/2152-2812.1013

However, if the non-addicted demand schedule is taken to be the marginal valuation schedule, then the consumer surplus would be P_RaP_C - abc**,** a much smaller cost than measured relative to the market demand schedule.

Figure 2
Consumer Surplus in the Presence of Addiction



(Adapted from: Australian Productivity Commission, 1999, Appendix C, 11-13)

This illustration raises two questions. First, is the non-addicted demand schedule the proper basis for measuring changes in social surplus? Second, if it is the proper basis, how can it be estimated?

Becker and Murphy (1988) argue that if consumers fully take account of the future effects of their current consumption, then the market demand schedule would be the appropriate basis for measuring welfare changes absent any externalities. They describe this as rational addiction. It is beyond the scope of

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

this analysis to assess fully whether the behavior they model can be described as rational as posited in standard welfare economics. We would argue that if so, it is a very strong and not particularly useful definition of rationality. Most particularly, their model employs constant exponential discounting which in turn implies time consistent decisions and allows for no "weakness of will" lapses or regret. Clarke and Danilkina (2006) note that Samuelson introduced constant exponential discounting into consumer choice models (Samuelson, 1937) and point out that Samuelson (1937:160) himself emphasized its mathematical arbitrariness and potential lack of generalizability: "… it is extremely doubtful whether we can learn much from considering such an economic man, whose tastes remain unchanged, who seeks to maximize some functional form of consumption alone, in a perfect world, where all things are certain and synchronized. For in any case such a functional would have to be dependent upon certain parameters which are socially determined … In general, there is strong reason to believe that changes in such parameters are not of an equilibrating nature."

The empirical case for rational addiction is also questionable. It is generally based on analysis of aggregate demand for the good over time. As noted by Auld and Grootendorst (2004) and others, the econometric methods employed find many goods addictive, not just the ones for which there is scientific evidence of physical addiction. This problem arises because it is empirically difficult, although not impossible (Farrell, Morgenroth, and Walker, 1999; Gruber and Koszegi, 2001; Guryan and Kearney, 2009), to distinguish between serial correlation in consumption arising from stable preferences and some fundamental causal relationship between present and future consumption.

If consumers are time inconsistent or are otherwise myopic in the sense of not fully anticipating the consequence of future consumption, then the market demand schedule is not the proper basis for measuring welfare change. Myopia refers not just to extreme impatience as would be modeled with very high discount rates, but any significant failure to take account of the future. With respect to goods that are generally physiologically addictive, there a number of causal pathways through which consumers may misjudge their addictive properties. For example, most smokers begin smoking as juveniles who underestimate the addictive properties of nicotine (Taylor and Brown, 1988; Gruber, 2002/2003). Similarly, those experimenting with recreational drug use are unlikely to be fully aware of the risks many of these drugs, especially the stimulants, pose for physical addiction. One increasingly recognized reason for individuals' inability to anticipate addiction risks may be lack of knowledge about their own genetic make-up that could predispose them to heightened risk of addiction. Current estimates are that genetic factors contribute between 40 and 60 percent to addiction vulnerability (Uhl, 2004; Goldman, Oroszi, and Ducci, 2005).

DOI: 10.2202/2152-2812.1013

For example, the A1 allele of the dopamine receptor gene *DRD2* appears to be more common in those addicted to cocaine or alcohol (for a recent review, see Li, Mao, and Wei, 2008).

With respect to goods that are psychologically or behaviorally addictive, consumers are unlikely to know prior to use whether or not they will be prone to addiction. While most people can gamble without escalating their gambling expenditures to destructive levels, a small fraction of people cannot restrain themselves. Prior to some experience with gambling, people are unlikely to know their type so that those who are prone to addiction inadvertently become addicted.

To determine how to take account of addiction in BCA an explicit utility model is required. Weimer, Vining, and Thomas (2009) employ one such simple utility model:

$$U = x + \alpha c - \rho(c-S)^2$$

where c is consumption of the addictive good, x is the consumption of all other goods, S is the index of addiction, and α and ρ are non-zero parameters. Assuming a budget constraint of B_A and prices for x of p_x and of addictive good c of p_c, respectively, and solving the first order conditions for x and c and substituting them into the above, yields the following expression for the maximum utility, W*:

$$W^* = \left[\frac{B_A - p_c S}{p_x}\right] - \left[\frac{\alpha\, p_c}{2\rho\, p_x}\right] + \left[\frac{p_c^2}{2\rho\, p_x^2}\right] + \rho\left[\frac{\alpha}{2\rho} - \frac{p_c}{2\rho\, p_x}\right]^2$$

In this simple case, if S were set to 0, that is the person were no longer addicted, then decreasing B_A by an amount p_cS would leave the utility unchanged. Therefore, p_cS is the compensating variation for the elimination of the addiction. That is, the person would be willing to pay p_cS in return for removal of the addiction.

Letting p_x = \$1, yields the following demand schedule for the additive good:

$$c = \frac{\alpha}{2\rho} + S - \frac{p_c}{2\rho}$$

where the slope is -1/2ρ. As S becomes larger (the good is more addictive), the amount demanded at every price increases. Also, as ρ becomes larger, demand becomes less elastic.

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

Weimer, Vining, and Thomas (2009) employ contingent valuation to estimate smokers' willingness to pay for removal of addiction, and therefore to estimate p_cS. This enables them to remove addicted demand from the market demand schedule. Their procedure results in estimates of social cost of a price rise in the cost of cigarettes of only about 75 percent of the social surplus loss measured using the market demand schedule. It should be viewed as an upper bound, for two reasons. First, despite the overwhelming scientific evidence on the addictiveness of cigarettes, about 14 percent of cigarette smokers responding to the survey reported that they believed that they were not physically addicted. Second, the treatment removing addiction in the contingent valuation elicitation question was described as involving injection, which may have depressed positive responses to bid prices——one relevant study suggests that about 15 percent of respondents may have rejected bid prices solely because of aversion to injection (Steiner et al., 2002). Consequently, this one study is only suggestive. It also relates only to the demand for cigarettes. Therefore, *more studies are needed to develop confident estimates of non-addicted demand for goods with addictive properties*.

Absent confident estimates of the fraction of market demand resulting from addicted demand, how should changes in consumption of addicted demand be treated in BCA? As a first step, the analysts should assess the degree of addictiveness of the good. This requires analysts to address two questions. First, what is the evidence about the physical addictiveness of the good in question? Nicotine perhaps anchors that upper end of the scale, followed by stimulants, opiates, alcohol, and marijuana. Second, what is the evidence concerning psychological or behavioral addiction? Especially with this latter category, it is important to assess the extent to which people are susceptible to addiction. For example, most people are susceptible to nicotine addiction while evidence suggests that only about 2 percent of the population is susceptible to gambling addiction. Answering these questions provides at least some basis for assessing whether or not addictive demand is a large component of market demand. At a minimum, *analysts applying BCA to policies affecting the consumption of addictive goods should be explicit about their assumptions concerning the proportion of addicted consumers and their estimate of the consumer surplus reduction*. In view of the uncertainty surrounding the effects of addiction on market demand, *these BCAs should incorporate a range of estimates for addictive demand in their Monte Carlo and other sensitivity analyses*.

CONCLUSION

BCA offers great potential for informing choices about desirable social policies. Realizing this potential, however, requires that the community of scholars with

skills in BCA invest in developing evidence-based shadow prices required for monetizing the most common social-policy impacts. In some cases, such as shadow prices for the costs of crime or marginal excess tax burden, estimates are available but require more research to narrow their ranges and verify their validities. In other cases, such as shadow prices for the social benefits of schooling, willingness to pay for redistribution, or the treatment of addictive demand, creativity is needed to develop estimates where none are now available. Analysts should also look for opportunities to develop appropriate shadow prices for short-run impacts of the sort most commonly estimated from program evaluations and experiments. Such efforts will most likely require the creative use of empirical evidence of all kinds to link short run effects to outcomes for which we have or can develop shadow prices.

In view of the large number of uncertain effects and shadow prices involved in applying BCA to social policies, analysts must take special care in dealing with uncertainty. Rather than setting estimates of effects equal to zero when their estimates are statistically insignificant, a more appropriate approach is to take account of the uncertainty of these effects in Monte Carlo simulations.

REFERENCES

Adam, Taghreed, David B. Evans, and Marc A Koopmanschap (2003) Cost-Effectiveness Analysis: Can We Reduce Variability in Costing Methods? *International Journal of Technology Assessment in Health Care* 19(2), 407-420.

Aghion, Philippe, Eve Caroli, and Cecilia Garcia-Penalosa (1999) Inequality and Economic Growth: The Perspective of the New Growth Theories. *Journal of Economic Literature* 37(4), 1615-1660.

Anderson, Michael L. (2008) Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects. *Journal of the American Statistical Association* 103(484), 1481-1495.

Anguera, Ricard (2006) The Channel Tunnel—An Ex Post Economic Evaluation. *Transportation Research Part A: Policy and Practice* 40(4), 291-315.

Aos, Steve, Roxanne Lieb, Jim Mayfield, Marna Miller, and Annie Pennucci (2004) Benefits and Costs of Prevention and Early Intervention Programs. Olympia: Washington State Institute for Public Policy.

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

Auld, M. Christopher, and Paul Grootendorst (2004) An Empirical Analysis of Milk Addiction. *Journal of Health Economics* 23(6), 1117-1133.

Australian Productivity Commission (1999) *Australia's Gambling Industries*, Inquiry Report No. 10, 26 November, available at www.pc.gov.au/inquiry/gambling/finalreport/index.html.

Ballard, Charles L., John B. Shoven, and John Whalley (1985) General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States. *American Economic Review* 75(1), 128-38.

Baron, Richard C., and Mark S. Salzer (2002) Accounting for Unemployment among People with Mental Illness. *Behavioral Sciences and the Law* 20(6), 585-599.

Becker, Gary S., and Kevin M. Murphy (1988) A Theory of Rational Addiction. *Journal of Political Economy* 96(4), 675-700.

Blomquist, Glenn, C., Paul A. Coomes, Christopher Jepsen, Brandon C. Koford, and Kenneth R. Troske (2009) Estimating the Social Value of Higher Education: Willingness to Pay for Community and Technical Colleges. IZA DP No. 4086, Bonn, Germany.

Boardman, Anthony E., David H. Greenberg, Aidan R. Vining, and David L. Weimer (2006) *Cost-Benefit Analysis: Concepts and Practice*, 3rd Ed. Upper Saddle River, NJ: Prentice Hall.

Boardman, Anthony E., Wendy L. Mallery, and Aidan R. Vining (1994) Learning form Ex Ante/Ex Post Cost-Benefit Comparisons: The Coquihalla Highway Example. *Economic Planning Sciences* 28(2), 69-84.

Butts, Jeffrey A., and John K. Roman (2009) Juvenile Crime Interventions. In David L. Weimer and Aidan R. Vining, eds. *Investing in the Disadvantaged: Assessing the Benefits and Costs of Social Policies*. Washington, D.C.: Georgetown University Press, 103-126.

Camerer, Colin (1997) Progress in Behavioral Game Theory. *Journal of Economic Perspectives* 11(4), 167-188.

Card, David (2001) Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems. *Econometrica* 69(5), 1127-1160.

Carson, Richard T. (forthcoming) *Contingent Valuation: A Comprehensive Bibliography and History*. Northampton, MA: Edward Elgar.

Cartwright, William S. (1998) Cost-Benefit and Cost-Effectiveness Analysis of Drug Abuse Treatment Services. *Evaluation Review* 22(5), 609-36.

Cartwright, William S. (2000) Cost-Benefit Analysis of Drug Treatment Services: Review of the Literature. *Journal of Mental Health Policy and Economics* 3(1), 11-26.

Caulkins, Jonathan P. (2009) Illicit Substance Abuse and Addiction. In David L. Weimer and Aidan R. Vining, eds., *Investing in the Disadvantaged: Assessing the Benefits and Costs of Social Policies*. Washington, D.C.: Georgetown University Press, 83-102.

Caulkins, Jonathan P., Rosalie Liccardo Pacula, Susan Paddock, and James Chiesa (2002) *School-Based Drug Prevention: What Kind of Drug Use Does It Prevent?* Santa Monica, Cal.: RAND.

Clarke, Harry, and Svetlana Danilkina (2006) Talking Rationally About Rational Addiction. Unpublished manuscript, LaTrobe University.

Cohen, Mark A. (1988) Pain, Suffering, and Jury Awards: A Study of the Cost of Crime to Victims. *Law & Society Review* 22(3), 537-556.

Cohen, Mark A., Roland T. Rust, Sara Steen, and Simon T. Tidd (2004) Willingness-to-Pay for Crime Control Programs. *Criminology* 42(1), 89-109.

Copas, J. B (1997) Using Regression Models for Prediction: Shrinkage and Regression to the Mean. *Statistical Methods in Medical Research* 6(2), 167-183.

Currie, Janet (2001) Early Childhood Education Programs. *Journal of Economic Perspectives* 15(2), 213-238.

Davies, Jim (2003) Empirical Evidence on Human Capital Externalities. Economic Policy Institute Working Paper 2003-5. London, Ontario: University of Western Ontario.

Dee, Thomas S. (2004) Are There Civic Returns to Education? *Journal of Public Economics* 88(9-10), 1607-1720.

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

Dickie, Mark, and Victoria L. Messman (2004) Parental Altruism and the Value of Avoiding Accute Illness: Are Kids Worth More than Parents? *Journal of Environmental Economics and Management* 48(3), 1146-1174.

Diener, Alan, Bernie O'Brien, and Amiram Gafni (1998) Health Care Contingent Valuation Studies: A Review and Classification of the Literature. *Health Economics* 7(4), 313-326.

Drake, Elizabeth K., Steve Aos, and Marna G. Miller (2009) Evidence-Based Public Policy Options to Reduce Crime and Criminal Justice Costs: Implications in Washington State. *Victims and Offenders* 4(2), 179-196.

Drummond, F. Michael, Mark J. Sculpher, George W. Torrance, Bernie J. O'Brien, and Greg L. Stoddart (2005) *Methods for the Evaluation of Health Care Programmes*, 3rd ed. New York: Oxford University Press.

Eckstein, Otto (1961) A Survey of the Theory of Public Expenditure Criteria. In James M. Buchanan (ed.) *Public Finances: Needs, Sources and Utilization*. Princeton, N.J.: Princeton University Press, 439-494.

Effron, Bradley, and Carl Morris (1997) Stein's Paradox in Statistics. *Scientific American* 236, 119-127.

Egerton, J., D. Fox, and A. Leshner (1997) *Cost-Benefit and Cost-Effectiveness Analysis: Issues in the Evaluation of Illicit Drug Abuse,* Malden, UK: Blackwell.

Engle, Pär Jason, and David L. Weimer (2005) Enhancing Criminal Sentencing Options in Wisconsin: The State and County Correctional Partnership. *La Follette Policy Report* 15(1), 15-18.

Ettner, Susan L., David Huang, Elizabeth Evans, Danielle Rose Ash, Mary Hardy, Michael Jourabchi, and Yih-Ing Hser (2006) Benefit-Cost in the California Treatment Outcome Project: Does Substance Abuse Treatment 'Pay for Itself'? *Health Services Research* 41(1), 192-213.

Farrell, Lisa, Edgar Morgenroth, and Ian Walker (1999) A Time Series Analysis of U.K. Lottery Sales: Long and Short Run Price Elasticities. *Oxford Bulletin of Economics and Statistics* 61(4), 513-26.

Feldstein, Martin (1997) How Big Should Government Be? *National Tax Journal* 50(2), 197-213.

DOI: 10.2202/2152-2812.1013

Feldstein, Martin (1999) Tax Avoidance and the Deadweight Loss of the Income Tax. *Review of Economics and Statistics* 81(4), 674-680.

Fenwick, Elisabeth, Karl Claxton, and Mark Sculpher (2001) Representing Uncertainty: The Role of Cost-Effectiveness Acceptability Curves. *Health Economics* 10(8), 779-787.

Freeman, Richard B. (1997) Working for Nothing: The Supply of Volunteer Labor. *Journal of Labor Economics* 15(1), S140-S166.

French, Michael T., Helena J. Salome, Jody L. Sindelar, and A. Thomas McLellan (2002) Benefit-Cost Analysis of Addiction Treatment: Methodological Guidelines and Empirical Application Using the DATCAP and ASI. *Health Services Research* 37(2), 433-455.

Frohlich, Norman, Joe A. Oppenheimer, and Cheryl L. Eavey (1987) Choices of Principles of Distributive Justice in Experimental Groups. *American Journal of Political Science* 31(3), 606-636.

Gold, Marthe R., Joanna E. Siegel, Louise B. Russell, and Milton C. Weinstein (1996) *Cost-Effectiveness in Health and Medicine.* New York: Oxford University Press.

Goldman, David, Gabor Oroszi, and Francesca Ducci (2005) The Genetics of Addictions: Uncovering the Genes. *Nature Reviews. Genetics* 6, 521-532.

Grant, Jon E., Desai Rani, and Marc Potenza (2009). Relationship of Nicotine Dependence, Subsyndromal and Pathological Gambling, and Other Psychiatric Disorders: Data from the National Epidemiologic Survey on Alcohol and Related Conditions. *The Journal of Clinical Psychiatry* 70(3), 334-43.

Greenberg, David, and Genevieve Knight (2007) *Review of the DWP Cost Benefit Framework and How It Has Been Applied.* Her Majesty's Stationary Office, Leeds: Department of Work and Pensions.

Greenberg, David H., and Abigail Davis (2007) Evaluation of the New Deal for Disabled People: The Cost and Cost-Benefit Analyses. Research Report No. 431. Leeds, United Kingdom: Department of Work and Pensions.

Greenberg, David H., and Philip Robbins (2008) Incorporating Nonmarket Time into Benefit-Cost Analyses of Social Programs: An Application to the Self-Sufficiency Project. *Journal of Public Economics* 92(3-4), 766-794.

Grogger, Jeffrey, Lynn A. Karoly, and Jacob Alex Klerman (2002) *Consequences of Welfare Reform: A Research Synthesis.* Santa Monica, CA: Rand.

Grossman, Michael (2006) Education and Nonmarket Outcomes. In Erik Hanushek and F. Welch (eds.) *Handbook of the Economics of Education, Volume 1*. Amsterdam: North-Holland, Elsevier.

Gruber, Jonathan (2002/2003) Smoking's Internalities. *Regulation* 25(4), 52-57.

Gruber, Jonathan, and Botond Koszegi (2001) Is Addiction 'Rational'? Theory and Evidence. *Quarterly Journal of Economics* 116(4), 1261-1303.

Gruber, Jonathan, and Emmanuel Saez (2002) The Elasticity of Taxable Income: Evidence and Implications. *Journal of Public Economics*, 84 (1), 1-32.

Guryan, Jonathan, and Melissa Schettini Kearney (2009) Is Lottery Gambling Addictive? NBER Working Paper Series, No. 14742.

Hammett, Theodore M., Mary Patricia Harmon and William Rhodes (2002) The Burden of Infectious Disease Among Inmates of and Releasees from US Correctional Facilities, 1997. *American Journal of Public Health* 92(11), 1789-1794.

Hanushek, Erik A., and Ludger Woessmann (2008) The Role of Cognitive Skills in Economic Development. *Journal of Economic Literature* 46(3), 607-668.

Harberger, Arnold C. (1978) On the Use of Distributional Weights in Social Cost-Benefit Analysis. *Journal of Political Economy* 86(2), S87-S120.

Harmon, Colm, Hessel Oosterbeek, and Ian Walker (2003) Returns to Education: Microeconomics. *Journal of Economic Surveys* 11(1), 115-155.

Harwood, Henrick J., Douglas Fountain, and Gina Livermore (1999) Economic Cost of Alcohol and Drug Abuse in 1992: A Report. *Addiction* 94(5), 631-647.

Haveman, Robert, and Barbara Wolfe (1984) Schooling and Economic Well-Being: The Role of Nonmarket Effects. *Journal of Human Resources* 19(3), 377-407.

Haveman, Robert (1965) *Water Resources Investment and the Public Interest*. Nashville, Tenn.: Vanderbilt University Press.

DOI: 10.2202/2152-2812.1013

Hayward, Mark D., William Grady, and John O. Billy (1992) The Influence of Socioeconomic Status on Adolescent Pregnancy. *Social Science Quarterly* 73(4), 750-772.

Heckman, James J. (2006) Skill Formation and the Economics of Investing in Disadvantaged Children. *Science* 312(5782), 1900-02.

Heckman, James J., Lance J. Lochner, and Petra E. Todd (2006) Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond. In Eric A. Hanushek and Finis Welch, eds., *Handbook of the Economics of Education*, 1. Amsterdam: Elsevier, North-Holland.

Her Majesty's Treasury (2009) *Green Book: Appraisal and Evaluation in Central Government*. http://www.hm-treasury.gov.uk/data_greenbook_index.htm, Accessed June 16, 2009.

Hogg, R.C., and D. Bertrand (2004) What Genes Tell Us about Nicotine Addiction. *Science* 306, November 5, 983-4.

Krutilla, Kerry (2005) Using the Kaldor-Hicks Tableau Format for Cost-Benefit Analysis and Policy Evaluation. *Journal of Policy Analysis and Management* 24(4), 864-875.

Lam, David, and Suzanne Duryea (1999) Effects of Schooling on Fertility, Labor Supply, and Investments in Children, with Evidence from Brazil. *Journal of Human Resources* 34(1), 160-192.

Laux, Fritz L. (2000) Addiction as a Market Failure: Using Rational Addiction Results to Justify Tobacco Regulation. *Journal of Health Economics* 19(4), 421-437.

Li, Chuan-Yun, Xizeng Mao, and Liping Wei (2008) Genes and (Common) Pathways Underlying Drug Addiction. *PLoS Computational Biology* 4(1): e2.

Ludwig, Jens, and Philip J. Cook (2001) The Benefits of Reducing Gun Violence: Evidence from Contingent-Valuation Survey Data. *Journal of Risk and Uncertainty* 22(3), 207-26.

Lynch, Allen K., and David W. Rasmussen (2001) Measuring the Impact of Crime on House Prices. *Applied Economics* 33(15), 1981-89.

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

MacCoun, Robert, Peter Reuter, and Thomas Schelling (1996) Assessing Alternative Drug Control Regimes. *Journal of Policy Analysis and Management* 15(3), 330-352.

Miller, Ted R., and Mark Cohen (1997) Costs of Gunshot and Cut/Stab Wounds in the United States, with some Canadian Comparisons. *Accident Analysis and Prevention* 29(3), 329-341.

Miller, Ted R., Mark A. Cohen, and Brian Wiersema (1996) *Victim Costs and Consequences: A New Look*. Washington, D.C.: National Institute of Justice.

Milligan, Kevin, Enrico Moretti, and Philip Oreopoulos (2004) Does Education Improve Citizenship? Evidence from the United States and the United Kingdom. *Journal of Public Economics* 88(9-10), 1667-1695.

Moore, Tim (2007) Working Estimates of the Social Costs per Gram and per User for Cannabis, Cocaine, Opiates and Amphetamines. Sydney: National Drug and Alcohol Research Centre, Drug Policy Modelling Program Monograph Series, No. 14.

Morris, Pamela (2001) *How Welfare and Work Policies Affect Children: A Synthesis of Research*. New York: MDRC.

Mukamel, Dana B., Heather Taffet Gold, and Nancy M. Bennett (2001) Cost Utility of Public Clinics to Increase Pneumococcal Vaccines in the Elderly. *American Journal of Preventive Medicine* 21(1), 29-34.

Narayanan, Sridhar, and Puneet Manchanda (2008) An Empirical Analysis of Individual Level Casino Gambling. Stanford Graduate School of Business, Research Paper No. 2003.

Nicholson, Sean, Mark V. Pauly, Daniel Polsky, Claire Sharda, Helena Szek, and Marc L. Berger (2006) Measuring the Effects of Workloss on Productivity with Team Production. *Health Economics* 15(2), 111-123.

Nicol, Kristin L. (2001) Cost-Benefit Analysis of a Strategy to Vaccinate Healthy Working Adults against Influenza. *Archives of Internal Medicine* 161(5), 749-759.

Olsen, Jan Abel, and Jeff Richardson (1999) Production Gains from Health Care: What Should Be Included in Cost-Effectiveness Analyses? *Social Science & Medicine* 49(1), 17-26.

Olsen, Jan Abel (1994) Production Gains: Should They Count in Health Care Evaluations? *Scottish Journal of Political Economy* 41(1), 69-84.

Oreopoulos, Philip (2006) Estimating Average and Local Average Treatment Effects of Education When Compulsory Schooling Laws Really Matter. *American Economic Review* 96(1), 152-175.

Perneger, Thomas V. (1998) What's Wrong with Bonferroni Adjustments. *British Medical Journal* 316(7139), 1236-1238.

Potenza, Marc T., Thomas R. Kosten, and Bruce J. Rounsaville (2001) Pathological Gambling. *Journal of the American Medical Association* 286(2), 141-44.

Rogers, Mark (2003) A Survey of Economic Growth. *Economic Record* 79(244), 112-135.

Roman, John K., and Christy Visher (2009) Prisoner Reentry Programming. In David L. Weimer and Aidan R. Vining, eds., *Investing in the Disadvantaged: Assessing the Benefits and Costs of Social Policies*. Washington, D.C.: Georgetown University Press, 127-150.

Samuelson, Paul A. (1937) A Note on Measurement of Utility. *Review of Economic Studies* 4(2), 155-61.

Steiner, MaryAnn, Lee C. Vermeulen, John Mullahy, and Mary S. S. Hayney (2002) Factors Influencing Decisions Regarding Influenza Vaccination and Treatment: A Survey of Health Care Workers. *Infection Control and Hospital Epidemiology* 23(10), 625-627.

Tapper, Andrew, Sheri McKinney, Raad Nashmi, Johannes Schwarz, Purnima Deshpande, Cesar Labarca, Paul Whiteaker, Michael J. Marks, Allan C. Collins, and Henry A. Lester (2004) Nicotine Activation of a4* Receptors: Sufficient for Reward, Tolerance, and Sensitization. *Science* 306, November 5, 1029-32.

Taylor, Shelley E., and Jonathon D. Brown (1988) Illusion and Well-Being: A Social Psychological Perspective on Mental Health. *Psychological Bulletin* 103, 193-210.

Uhl, G.R. (2004) Molecular Genetic Underpinnings of Human Substance Abuse Vulnerability: Likely Contributions to Understanding Addiction as a Mnemonic Process. *Neuropharnacology* 47 (Supplement 1), 140-147.

https://doi.org/10.2202/2152-2812.1013 Published online by Cambridge University Press

Weimer, David L., and Mark A. Sager (2009) Early Identification and Treatment of Alzheimer's Disease: Social and Fiscal Outcomes. *Alzheimer's & Dementia* 5(3), 215-226.

Weimer, David L., and Aidan R. Vining (2009) *Investing in the Disadvantaged: Assessing the Benefits and Costs of Social Programs*. Washington, D.C.: Georgetown University Press.

Weimer, David L., Aidan R. Vining, and Randall K. Thomas (2009) Cost-Benefit Analysis Involving Addictive Goods: Contingent Valuation to Estimate Willingness-to-Pay for Smoking Cessation. *Health Economics* 18(2), 181-202.

Weinstein, Milton C., Joanna E. Siegel, Alan M. Garber, Joseph Lipscomb, Bryan R. Luce, Willard G. Manning, Jr., and George Torrance (1997) Productivity Costs, Time Costs and Health-Related Quality of Life: A Response to the Erasmus Group. *Health Economics* 6(5), 505-510.

Weisbrod, Burton A. (1968) Income Redistribution Effects and Cost-Benefit Analysis. In S. B. Chase, ed., *Problems in Public Expenditure Analysis*. Washington, D.C.: The Brookings Institution, 177-208.

Weisbrod, Burton A. (1981) Benefit-Cost Analysis of a Controlled Experiment: Treating the Mentally Ill. *Journal of Human Resources* 16(4), 523-548.

Wolfe, Barbara, and Nathan Tefft (2009) Early Childhood Interventions. In David L. Weimer and Aidan R. Vining, eds., *Investing in the Disadvantaged: Assessing the Benefits and Costs of Social Policies*. Washington, D.C.: Georgetown University Press, 17-29.

Wolfe, Barbara, and Robert Haveman (2001) Accounting for the Social and Non-Market Benefits of Education. In John F. Helliwell, ed., *The Contribution of Human and Social Capital to Sustained Economic Growth and Well Being*. Vancouver, B.C.: University of British Columbia Press, 221-250.

Zerbe, Richard O., Jr., Yoram Bauman, and Aaron Finkle (2006) An Aggregate Measure for Benefit-Cost Analysis. *Ecological Economics* 58(2), 449-461.

DOI: 10.2202/2152-2812.1013