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Toward Standardization of Benefit-Cost Analysis of Early Childhood Interventions

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Toward Standardization of Benefit-Cost Analysis of Early Childhood Interventions

Lynn A. Karoly

Abstract

A growing body of benefit-cost analyses (BCAs) of early childhood programs has been prompted by the increased demand for results-based accountability when allocating public and private sector resources. While the BCAs of early childhood programs serve to make such investments more compelling, there are limitations in the current state of the art, including a lack of standardization in the BCA methods used, from discount rates to shadow prices. The objective of this paper is to delineate a set of standards for conducting BCAs of early childhood programs. The paper reviews the existing evidence of the economic returns from early childhood programs that serve children and families in the first five years of life, discusses the challenges that arise in applying the BCA methodology such programs, highlights the variation in current methods used, and proposes a set of standards for applying the BCA methodology to early childhood programs. The recommendations concern issues such as the discount rate to use and the age to which costs and benefits should be discounted; stakeholder disaggregation; outcomes to value, the associated values, and projections of future outcomes; accounting for uncertainty; sensitivity analysis; and reporting of results. The proposed standards can guide the choices that analysts need to make about the methods to use when performing BCAs for one or more early childhood programs and they can support greater transparency in the results the analysts provide. The standards can also support consumers of the BCA results in their need to understand the methods employed and the comparability across different studies.

KEYWORDS: benefit-cost analysis, early childhood interventions

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INTRODUCTION

There is a growing body of evidence regarding the favorable effects of investing early in the lives of disadvantaged children through such programs as home visiting and early childhood education. Such programs have demonstrated short- and longer-term benefits for both participating children and their families through rigorous experimental and quasi-experimental evaluations (Karoly, Kilburn, and Cannon, 2005). Advocates who call for devoting more resources to such programs have drawn attention to the associated benefit-cost analyses (BCAs) which also show positive economic returns, whether to the participating families and children or to society more generally. As funders in the public and private sectors consider such investments, the evidence of favorable benefit-cost ratios, net benefits, or internal rates of return have further boosted enthusiasm for directing more resources to early childhood programs. Ultimately, the BCAs of early childhood programs fulfill the increased demand for results-based accountability when allocating public and private sector resources.

Although the BCAs of early childhood programs serve to make such investments more compelling, there are limitations in the current state-of-the-art. Most importantly, there are a number of decisions about the methods to employ when implementing a BCA – from discount rates to shadow prices – and analysts typically do not follow a standardized approach.[1] Moreover, there are several other challenges in applying the BCA approach to early childhood programs that further introduce potential differences in methods. These challenges include the economic values to attach to observed program outcomes, many of which do not have readily available economic values, and valuing potential benefits beyond the last observed outcomes. At present, most BCAs of early childhood programs provide proof-of-principle that the economic returns can be positive for a given program, but they do not support decision-makers who may want to use the results to choose between alternative approaches to early intervention or to assess the difference in the economic returns obtained from investing in early childhood versus investing later in childhood or versus investing in some other type of social program.

In this context, the objective of this paper is to delineate a set of standards for conducting BCAs of early childhood programs. Such standards can guide the choices that analysts need to make about the methods to use when performing BCAs for one or more early childhood programs and they can support greater

[1] One exception is the report by the Washington State Institute of Public Policy (WSIPP) which applies a common set of methods to estimate benefit-cost ratios and net benefits for an array of different early childhood programs (Aos et al., 2004). However, the comparability of even these estimates is limited by the fact that the underlying evaluations of the early childhood programs do not measure a common set of outcomes nor do they have a common follow-up period.

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transparency in the results the analysts provide. The standards can also support consumers of the BCA results in their need to understand the methods employed and the comparability across different studies. The standards outlined in this paper are intended to address issues specific to the use of BCA for early childhood programs. As such, this paper complements the related efforts to identify a set of principles and standards for the application of BCA to social programs more generally (see, for example, Vining and Weimer, 2009, 2010; Zerbe et al., 2010; Loomis, 2011), as well as recommendations for the use of BCA to assess social policy interventions in other areas such as crime (Lott, 2009), public safety (Farrow and Viscusi, 2010), and public health preparedness and pandemic mitigation (Cook, 2009).

To set the stage for the discussion of standards in the early childhood context, this paper proceeds in the next section by considering what early intervention is and the existing evidence of the economic returns from such programs. The discussion highlights the diversity of early intervention models and also calls attention to some of the challenges that arise in applying the BCA methodology to assess the economic returns to programs that serve children and families in the first 5 years of life. Despite this diversity, the available BCAs tend to show favorable economic returns, both modest and more sizeable, across effective programs.

In the third section, the paper provides a more in-depth discussion of the challenges of applying the BCA methodology to early intervention programs, considering each stage of the BCA process, from program evaluation to valuing program outcomes to generating estimates of net economic benefits or benefit-cost ratios. The discussion continues with a consideration of how these challenges are addressed in practice by reviewing the specific methods employed in existing BCAs of early childhood programs. This review underscores the general lack of standardization across BCA methods to date, although there is more agreement on some elements than others.

Motivated by the current state-of-the-art, the fourth section lays out a set of standards for applying the BCA methodology to early childhood programs. These recommendations are designed to encourage greater uniformity of methods and hence a higher degree of comparability across BCAs. For some components of the BCA methodology, the rationale for standardization is clear and standardization is feasible in practice. For others, even with clear principles, there are practical considerations that limit the possibility of fully standardized methods. However, even in such cases, sensitivity analyses can support comparative analyses that will highlight the importance of key methods and resolve possible differences in findings across BCAs. Finally, this paper makes the case for greater transparency and uniformity in reporting BCA methods and results, even if the BCAs are not fully standardized across studies.

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ECONOMIC RETURNS FROM INVESTING IN CHILDREN PRIOR TO SCHOOL ENTRY

Before delving into a discussion of BCA methodology for early intervention, I first provide an overview of the approaches to early intervention. The section continues with a brief review of the BCAs conducted to date for such programs.

Strategies for intervention with at-risk children

As detailed in Karoly, Kilburn, and Cannon (2005), early childhood intervention programs incorporate a diverse array of strategies for improving the developmental trajectory of participating children, especially children facing various disadvantages such as low family income, low parental education, or early health risks (e.g., low birth weight), among other stressors. Table 1 illustrates some of this variation by delineating a series of program features and examples of how those features might be defined for any given early intervention program. For example, programs are designed to influence various outcomes for the participating child or the child's family (typically the mother), outcomes that might include some of those shown in Table 1 such as the child's own health or behavioral or cognitive development or outcomes for the child's mother such as her pregnancy outcomes (e.g., birth weight, gestation, or substance use), parenting skills, or education level. Programs vary in the extent to which they target the

Table 1 – Approaches to Early Childhood Intervention.

Program Feature	Examples	
Outcome targeted	Child behavior	Pregnancy outcomes
	Child cognition	Parenting skills
	Child health	Parent education
Target person(s)	Child	Child-parent dyad
	Parent	Family unit
Targeting mechanism	Family income	Parental problems
	Child health problems	Universal
Services offered	Family supports	Parenting
	Health/nutrition	Early education
Location of services	Home	Health provider
	Center, school	Other provider
Age of focal child	Prenatal to age 5 years, for shorter or longer durations	
Intensity of intervention	Starting to ending age	Hours per week
		Weeks per year

SOURCE: Based on Karoly, Kilburn, and Cannon (2005), Table 2.1.

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child, the parents, or both as the focus of the intervention. Most early intervention programs have some means of targeting services to those families that will benefit the most, although some take a universal approach and make the program available to all children or families regardless of their circumstances. Programs offer various combinations of services, depending on their objectives, and provide services in one or more settings that might include the child's home, a school or center, or a service provider's office such as a pediatric practice. Programs may begin their interventions as early as the prenatal period or wait to start until the child is closer to age 5 years when they would typically enter kindergarten. Depending on the nature of the services offered and the starting and ending ages, there is tremendous variation in the intensity of the services offered, ranging from full-day year-round services from birth to age 5 years to 15–20 hours of parent training classes at some point during the early childhood period.

The varied ways in which these program features are combined can be demonstrated with the following illustrative programs, drawn from 19 programs with rigorous research evaluations and demonstrated benefits reviewed by Karoly, Kilburn, and Cannon (2005) and ordered by the age of the focal child at intervention:

- *Nurse-Family Partnership (NFP)*. Provides a sequence of approximately 32 home visits to low-income first-time young mothers by public health nurses starting in the prenatal period and continuing until the child reaches age 2 years, with a focus on improving pregnancy outcomes, the mother's self-efficacy, and parenting skills.
- *Infant Health and Development Program (IHDP)*. Provides periodic home visits and full-day year-round developmentally appropriate center-based childcare services and other family supports to low birth weight babies starting a few weeks after birth and continuing to age 3 years.
- *Carolina Abecedarian Project*. Provides periodic home visits and full-day year-round developmentally appropriate center-based childcare and early education services, as well as other family supports, to very low-income children starting a few weeks after birth and continuing to kindergarten entry.
- *HIPPY (Home Instruction Program for Preschool Youngsters) USA*. Provides low-income low-education parents of children ages 3–5 years with a 2-year structured curriculum and associated materials that is delivered daily by parents at home, augmented with biweekly home visits from a paraprofessional trainer and biweekly meetings with the trainers and other parents.

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- *Chicago Child-Parent Centers (CPC)*. Provides children in high-poverty neighborhoods with a 1- or 2-year part-day school-year center-based developmentally appropriate preschool program with a strong parent involvement component.
- *High/Scope Perry Preschool Project*. Provides children with low income and low IQ scores with a 1- or 2-year part-day school-year center-based developmentally appropriate preschool program that also includes periodic home visits.

These six programs also happen to have accompanying BCAs, as discussed further in the next subsection.

The variation in early intervention programs contributes to some of the challenges for using BCA as part of policy evaluation of these programs. First, there is a diversity of outcomes that may be affected by programs and that would need to be valued in economic terms. Many of these outcomes – child development, parenting skills, and so on – may be considered "soft," in other words, not readily valued in monetary terms. Depending on the nature of the intervention, changes in outcomes may occur for the child, the parents, or both. Moreover, the evaluations for early interventions may not all assess the same outcomes or for the same targets or using the same measurement tools. Second, many early intervention programs aim to improve outcomes while the program is underway but most also expect to improve outcomes into the future, well beyond the end of program services. This may require longer-term follow-up or some method of projecting longer-term benefits and not all program evaluations may have the same capacity for such longer-term assessments. Third, programs may intervene at different points in early childhood, from the prenatal period to a year or less before kindergarten entry. When comparing the economic returns to different intervention strategies, it will be important to account for this temporal difference when resources are spent and benefits accrue. The discussion returns to these challenges and others, along with the implications for the BCA methodology, in the next section.

Evidence of the economic return to early childhood investments

BCAs have been conducted for the six early childhood interventions described in the previous subsection, either by the same team of researchers that conducted the program evaluation or through an independent analysis.[2] In some cases, more than

[2] Although the federal Head Start program has been evaluated using experimental and quasi-experimental designs, the program has not been subject to a formal benefit-cost analysis comparable to those for the other programs reported in Table 2. Ludwig and Phillips (2007) provide an assessment of whether the magnitude of the estimated Head Start impacts would

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one estimate has been made, either by different research teams or based on program evaluation results at different points in time. The estimated societal benefit-cost ratios for the BCAs of the six early childhood programs are reported in the top panel of Table 2. In addition, the bottom panel of Table 2 reports estimates that have been made for two early childhood program types – home visiting for at-risk mothers and children and early childhood education for low-income 3- and 4-year-olds – based on estimates of program effects from a meta-analysis of multiple interventions. The resulting benefit-cost ratios across both panels of Table 2 range from 0-to-1 to over 16-to-1.

As discussed further below, there are a number of differences in how the BCAs recorded in Table 2 were performed so that the resulting benefit-cost ratios are not strictly comparable across the interventions. However, these results offer "proof-of-principle" that early interventions can yield positive returns to society (Kilburn and Karoly, 2008). With one exception, the ratio of societal benefits to costs exceeds one for the array of early interventions. In the case of the IHDP, the program produced favorable child developmental benefits as of the last follow-up available at the time (age 8 years), but all benefits were in areas that could not be readily monetized (e.g., improved child IQ, home environment, and mother-child interactions). Hence, there were no dollar benefits to weigh against the program costs.[3]

For the other five intervention programs, the favorable economic returns are not only limited to smaller-scale demonstration projects such as Perry Preschool but they are also evident for larger-scale programs such as Chicago's CPC program which operated in the Chicago public school system. The positive benefit-cost ratios also apply to higher-cost more intensive programs such as Abecedarian (which provided full-day year-round center-based childcare and early education services for the child's first 5 years) and to lower-cost less intensive programs such as HIPPY USA (a 2-year parent-delivered in-home curriculum with periodic home visits and parent training). Furthermore, the favorable BCA results accrue to both types of early intervention: home visiting and center-based care and early education.

The results in Table 2 also illustrate the intuitive result that programs that target the population the program is designed to serve can have higher benefit-cost ratios. In the case of NFP, the original trial of the program in Elmira, New

translate into sufficient dollar benefits to outweigh the program costs. They conclude that the program would probably pass a benefit-cost test, consistent with a "back-of-the-envelope" assessment provided earlier by Currie (2001).

[3] A follow-up at age 18 years of the IHDP program participants and non-participants showed continued positive program impacts in areas such as academic achievement (McCormick et al., 2006), an outcome that could potentially be valued in terms of future projected earnings differentials.

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Table 2 – Reported Benefit-Cost Ratios for Early Childhood Interventions.

Program/Program Type	Source	Benefit-Cost Ratio
Estimates for Specific Programs		
NFP – full sample	Aos et al. (2004)	2.88[a]
NFP – higher-risk sample	Karoly et al. (1998)	5.06[b]
NFP – lower-risk sample	Karoly et al. (1998)	1.10[b]
IHDP	Aos et al. (2004)	0.00
Abecedarian	Masse and Barnett (2002); Barnett and Masse (2007)	2.49[c]
HIPPY USA	Aos et al. (2004)	1.80
Chicago CPC – Age 21 follow-up	Reynolds et al. (2002)	7.14
Chicago CPC – Age 26 follow-up	Reynolds et al. (2011)	10.83[a]
Perry Preschool – Age 19 follow-up	Berrueta-Clement et al. (1984)	3.56
Perry Preschool – Age 27 follow-up	Karoly et al. (1998)	4.11[b]
Perry Preschool – Age 27 follow-up	Barnett (1993, 1996), Schweinhart, Barnes, and Weikart (1993)	8.74[a]
Perry Preschool – Age 40 follow-up	Barnett et al. (2005), Nores et al. (2005), Belfield et al. (2006)	16.14[a]
Perry Preschool – Age 40 follow-up	Heckman et al. (2010)	7.1–12.2[a,d]
Estimates from Meta-Analysis of Intervention Types		
Home visiting for at-risk mothers and children	Aos et al. (2004)	2.27[a]
Early childhood education for low-income 3- and 4-year-olds	Aos et al. (2004)	2.36[a]

[a]Includes value of reduced intangible crime victim costs.
[b]Discount rate is 4%.
[c]From revised estimate in Barnett and Masse (2007).
[d]Reported range of estimates under alternative assumptions regarding the economic cost of crime.
SOURCE: Based on the cited sources.
NOTE: The benefit-cost ratios are the ratio of the present discounted value of total benefits to society as a whole (participants and the rest of society) divided by present discounted value of program costs. The discount rate is 3% unless otherwise noted. The value of reducing intangible crime victim costs are excluded unless otherwise noted.

York, so as not to stigmatize participants, served both the targeted higher-risk population of unmarried pregnant women with low socioeconomic status (SES) and a somewhat more advantaged group of pregnant women who were either married or had higher SES. As expected, compared with the lower-risk group, the program impacts were larger for the higher-risk group and hence estimated dollar

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benefits and the resulting benefit-cost ratio were also higher (a ratio just over 5-to-1 compared with a ratio just over 1).

Finally, the results for the BCAs of the Perry Preschool and Chicago CPC programs at each successive follow-up age demonstrate the advantage of being able to observe, rather than project, future benefits. For example, for the Perry Preschool program, based on observed outcomes as of age 19 years and with some projection of future benefits, the program was estimated by the High/Scope research team to produce a benefit-cost ratio just under 4-to-1 (Berrueta-Clement et al., 1984). Using a similar set of methods, the ratio more than doubled based on data analyzed by the team through age 27 years (again with some projection of future benefits) (Barnett, 1993, 1996; Schweinhart, Barnes, and Weikart, 1993) and then topped 16-to-1 when the study participants were observed again at age 40 years (Barnett et al., 2005; Nores et al., 2005; Belfield et al., 2006). In this case, the projections of future earnings gains after age 19 years or after age 27 years were too conservative, in part because those projections were based solely on the difference in educational attainment between participants and non-participants, whereas favorable effects of the program on other factors such as cognitive abilities, attitudes, and behavior also contributed to earnings gains (Karoly, 2008).[4] The BCAs for the Chicago CPC program as of age 21 years and then age 26 years show a similar pattern, with a 50% increase in the estimate benefit-cost ratio with additional follow-up data. Such a pattern of increasing economic returns with more follow-up data is not always assured. Program benefits may fade out over time, in which case projections beyond the age of the last follow-up may overstate future benefits.

CHALLENGES IN APPLYING BCA TO EARLY CHILDHOOD INVESTMENTS

The use of BCA for evaluating early childhood interventions requires a series of steps that define the BCA methodology, as illustrated in Figure 1 [Karoly, 2009; National Research Council (NRC) and Institute of Medicine (IOM), 2009]. The starting point is a program of interest (the purple oval) that is compared with a baseline or alternative (the white oval), typically a "no program" alternative but the comparison may also be made to another type of early childhood program or programs. Next, an evaluation is conducted that compares the program of interest with the baseline (the yellow box), in terms of both program costs and outcomes

[4] The results from Heckman et al. (2010) indicate, however, that the estimated benefit-cost ratios from the series of High/Scope studies of Perry Preschool are sensitive to the use of alternative methods, as discussed later in the paper.

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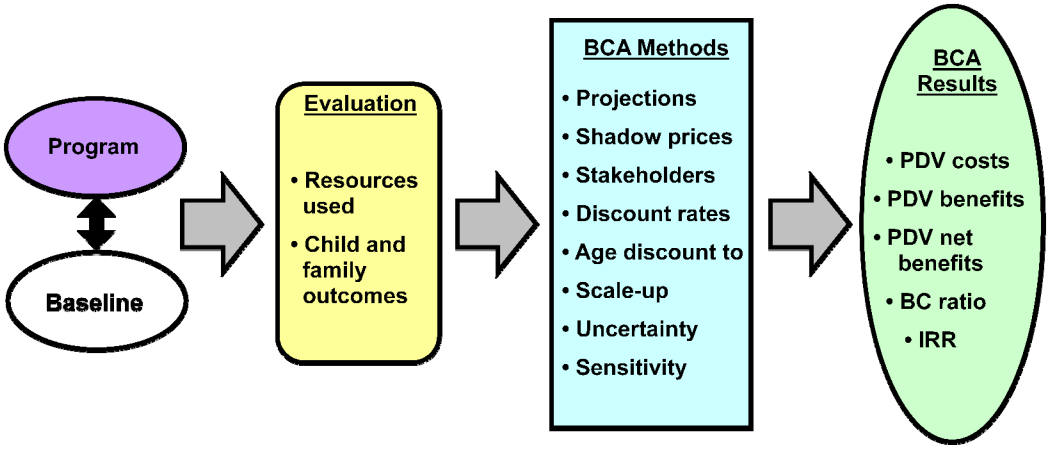
Figure 1 – Elements of Benefit-Cost Analysis.



SOURCE: Karoly (2009) and National Research Council (NRC) and Institute of Medicine (IOM), 2009, Figure 1.1.

for program participants. This may be done through an experimental evaluation where the participants in the experiment are randomly assigned to receive the treatment of interest or to be in the control group (which receives the baseline or alternative). When an experiment is not feasible or is too costly, quasi-experimental methods may be used to evaluate differences in costs and outcomes for the program group against a comparison group. The results of the evaluation then form the basis for implementing the BCA methodology (the blue rectangle) which requires making decisions about such aspects as projecting outcomes into the future, valuing outcomes using shadow prices, applying discount rates, addressing uncertainty, and conducting sensitivity analyses. A given set of methods finally leads to the BCA results (the green oval) which may be expressed in terms of present discounted value costs, benefits, and net benefits, or in terms of benefit-cost ratios or internal rates of return.

Keeping this framework in mind, I now highlight the key challenges in implementing the BCA methodology in the context of early childhood interventions.[5] I then illustrate the consequences in practice in terms of the lack of standardization across BCAs of early childhood programs on such elements as discount rates, age discounted to, benefits that are monetized, methods for projecting future or unobserved benefits, and shadow prices.

[5] Most of these issues apply more generally to BCAs of other types of social programs. See Karoly (2008) for additional discussion.

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Conducting rigorous evaluations to measure program costs and causal effects

The field of early childhood intervention has been characterized by a long history of evaluation research, with a proliferation of evaluation studies beginning in the 1960s including those for Perry Preschool, the Early Training Project, and the Head Start Project (Karoly et al., 1998).[6] Although many early intervention programs do not include a well-implemented formal experimental or quasi-experimental evaluation, there are many that do. For example, Karoly, Kilburn, and Cannon's (2005) review identified 20 early intervention programs with rigorous evaluations that met specific criteria such as a published evaluation that had an adequate control or comparison group and a sufficient sample size. However, even well-designed experimental or quasi-experimental evaluations may have issues with missing data, sample attrition over the follow-up period, or other threats to validity (e.g., treatment-control crossovers). For example, Heckman et al. (2010) reanalyze the Perry Preschool evaluation data, accounting for several problems with the experimental evaluation including compromised randomization due to reassignment of treatment and control group members after randomization and missing data.

One issue in the use of BCA for early childhood interventions is that the evaluations do not always employ the same baseline or alternative to compare with the program of interest. Of the programs listed in Table 2, for example, the Perry Preschool program was evaluated in the 1960s when the alternative or *status quo* for most children was no formal early education. By contrast, in the recent national experimental Head Start evaluation, many children in the control group attended some other type of early education program, whereas some who were randomized into the treatment group did not attend Head Start (US Department of Health and Human Services, 2005; Ludwig and Phillips, 2007). In some cases, the control group children just attended a different Head Start than the one they had been randomized out of. As another example, IHDP and Abecedarian, also listed in Table 2, provided some health, developmental, or family services to the control group. For these two programs, the measures of program effects are relative to a baseline that includes some remedial services rather than a "no program" baseline.

In the case of the Head Start evaluation, Ludwig and Phillips (2007) convert the "intent-to-treat" (ITT) estimates reported in the Head Start evaluation

[6] There are many comprehensive reviews of this literature, often with a particular focus on different types of intervention models (e.g., preschool or home visiting) or benefits for particular participants (e.g., children or parents). Earlier and more recent examples include Meisels and Shonkoff (1990), Benasich, Brooks-Gunn, and Clewell (1992), Barnett (1995), Yoshikawa (1995), Karoly et al. (1998), Brooks-Gunn, Berlin, and Fuligni (2000), Shonkoff and Phillips (2000), and Karoly, Kilburn, and Cannon (2005).

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into "treatment-on-treated" (TOT) estimates, an approach that is valid under certain assumptions.[7] When it is not possible to generate program impact estimates relative to no participation, differences in the baselines used in the evaluations of different interventions will in turn affect the validity of direct comparisons of the BCA results for these programs. We might expect the gains from more recent interventions to be lower compared with programs implemented several decades ago because of the change in the baseline or "no program" alternative. In the same way, an evaluation that provided some limited services to the control group might be expected to produce smaller benefits than would have been found if no services were offered to the controls. Thus, a head-to-head comparison between old and new generation programs or between programs with other differences in the baseline services would not be valid.

Another issue with evaluations of early childhood programs is that costs are not always measured with the same rigor as benefits. Ideally, the evaluation would capture the incremental costs associated with the program relative to the baseline or alternative. In cases where the alternative includes some services, this means collecting cost data for both the program group and the no program group. For both groups, the cost data should allow for estimation of the full economic costs associated with program delivery, including both resources that require cash outlays, as well as the opportunity costs associated with resources that may be provided in-kind (e.g., space provided without charge or at a subsidized rate or volunteer labor). The most rigorous approach uses the resource cost method (RCM) outlined by Levin and McEwan (2000), an ingredients-based approach that collects detailed information on the actual quantities of labor and non-labor resources used and then attaches market prices or shadow prices to each resource employed. Instead of this ideal, it is not uncommon with early childhood evaluations to base estimates of program costs on budget or expenditure data, without fully accounting for in-kind resources utilized or the full economic costs associated with each resource. The opportunity costs of the time that participants spend in the program are also often overlooked.

Measuring program effects on child or family outcomes in short term and longer term

Given the varied objectives of and approaches to early intervention, it is perhaps not surprising that evaluations have measured a diverse array of outcomes and found favorable effects for many of these outcomes in both the shorter term and

[7] See Ludwig and Phillips (2007) for further discussion of the Head Start case, along with Heckman, LaLonde, and Smith (1999) for a more general discussion of accounting for intent to treat and substitution bias.

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longer term, with benefits for both participating children and their parent(s). It is even possible that early interventions would have effects on the children of program participants or even their grandchildren (Masse and Barnett, 2002). Table 3 lists outcomes within five domains where early intervention programs have demonstrated statistically significant benefits, at least in the short term. For several evaluations where long-term follow-up has been possible, the outcomes in Table 3, such as higher rates of high school graduation, increased earnings, reduced welfare use, and lower rates of crime and delinquency, represent favorable effects for program participants long after the program has ended. Indeed, in the case of Perry Preschool, statistically significant favorable impacts were still evident when the participants were age 40 years, around 35 years after the program ended (Schweinhart et al., 2005).

The types of outcomes affected, how they are measured and for whom, and the timing of program effects create several challenges for the use of BCA to assess early childhood programs. First, given resource constraints, evaluations of early intervention programs are not able to measure and assess all possible outcomes that may be favorably affected. Typically, each evaluation focuses on a set of outcomes given the goals of that particular intervention. As a result, at any given point in time during or after an intervention, there may be outcomes affected by the program that are not measured as part of the evaluation and hence

Table 3 – Outcomes with Favorable Impacts from Early Interventions.

Domain	Outcomes for Participating Child	Outcomes for Participating Parent(s)
Behavioral/ emotional and cognitive development	Behavior Social competence IQ Developmental milestones	Parent-child relationships Home environment
Education	School readiness Achievement tests Grade repetition Special education use Grades High school completion College attendance	Educational attainment
Health	Abuse and neglect Health care utilization Teen pregnancy	Reproductive health
Economic	Employment Earnings Use of social welfare programs	Employment Earnings Use of social welfare programs
Crime and substance abuse	Criminal activity Use of tobacco, alcohol, and drugs	Criminal activity Use of tobacco, alcohol, and drugs

SOURCE: Based on Karoly et al. (1998) and Karoly, Kilburn, and Cannon (2005).

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cannot be captured in the BCA. For example, most early childhood interventions focus on outcomes for the participating child and do not attempt to assess effects on their parent(s). For programs that provide center-based early care and education, it is possible that parents benefit in terms of their ability to work, which can raise their labor market experience and earnings, and thereby reduce welfare use or even criminality. In the case of home visiting programs, improved maternal outcome is often a central objective and thus evaluations have incorporated parental outcomes. Indeed, favorable effects on parent outcomes have been found in selective evaluations (e.g., Abecedarian, NFP), but most have not assessed parental outcomes and thus any benefits are unknown.

Second, for a number of the potential benefits of early interventions, the evaluation field has not converged on a common set of measures. Thus, for example, while one goal of the intervention may be to increase child IQ or to raise school readiness, researchers rely on different assessment tools to measure those constructs. In other cases, evaluators have to rely on measures that are feasible, thus it is not always possible to include the same outcomes measure as other evaluations. In the case of criminal activity in adolescence or adulthood, for example, researchers often rely on administrative data which may capture criminal activity only one way, such as by arrests, adjudications, convictions, or time in jail or prison.

Third, resource constraints can also affect the ability to conduct long-term follow-up of the interventions. This can be a real detriment as many of the benefits of early intervention may persist into the future, as has been found in those interventions with longer-term follow-up, as noted above. The longer-term favorable effects for such outcomes as high school completion, earnings, and criminality also happen to be the outcomes with some of the largest dollar benefits, even after discounting. In the absence of longer-term follow-up, potential future benefits remain unknown or researchers must rely on methods for projecting those outcomes into the future. For example, favorable effects on achievement tests may be used to project an effect on high school graduation rates. Effects on crime and delinquency in adolescence may be used to project criminality during adulthood. The use of projections, while typically based on other empirical research, introduces considerable uncertainty. This is especially true for longer-term benefits that have been theorized – such as effects on descendants – but not yet confirmed in any evaluations. The use of projections to value unmeasured future benefits is another source of variation in methods across BCAs.

With each study measuring a different set of outcomes, using different measures, for different participants, or over different time horizons, it is not possible for BCAs of different programs to value the same set of observed outcomes or to make projections for those outcomes over the same future horizon.

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This may mean that interventions measuring a smaller set of outcomes or with little or no longer-term follow-up will leave more potential benefits unmeasured compared with evaluations that measure a broader range of outcomes over a longer time horizon.

Generating economic values or "shadow prices" for resources used and outcomes affected

The range of domains and specific outcomes measures shown in Table 3 also presents a challenge for BCA of early intervention programs because many outcomes do not have an economic value that can be observed in the marketplace. In such cases, shadow prices are used in BCAs to capture the appropriate economic value in terms of willingness to pay: what consumers are willing to forgo to obtain a given benefit or avoid a given cost. Shadow prices may be used when markets exist but there is a need to correct for distortions in market prices (e.g., as a result of externalities, monopoly power, rent-seeking, underemployed labor or other resources, taxes or subsidies, or other market imperfections). Shadow prices may also be used to value outcomes for which there are no market prices or those for which there are both tangible and intangible benefits (Karoly, 2008).

Many of the outcomes listed in Table 3 do not have a market value to readily apply as a benefit or cost. What is the economic value of raising a child's IQ or their school readiness?[8] What dollar value should be placed on a reduction in child abuse and neglect?[9] Even outcomes such as increased earnings, which are valued in dollars, may need to be adjusted to account for effects on participant well-being (or utility) or externalities. For example, if an increase in employment and earnings for a program participant comes through displacing another worker in the labor market, the gain in individual earnings is not the same as the social benefit. In addition, if all or part of the earnings gain derives from an increase in hours, the value of reduced leisure time may also need to be taken into account (Karoly, 2008). As another example, BCAs for early childhood programs do not always account for the marginal excess tax burden when assigning a value to the increased taxes generated from higher participant earnings.[10] Often, such adjustments, which are consistent with economic theory, are not taken into account in practice either because of data limitations or current practice. Shadow

[8] The association between IQ and earnings has been used to assign an economic value to IQ gains. See, for example, the method employed by the US Environmental Protection Agency (EPA) is estimating the benefits from lead reduction (US Environmental Protection Agency, 2008).
[9] Again, estimates are available of the economic costs of abuse and neglect.
[10] The Heckman et al. (2010) BCA for Perry Preschool is one exception in incorporating alternative assumptions about the magnitude of the deadweight loss from taxation.

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prices may also vary across markets so that geographic differences come into play. In some cases, BCAs are conducted with a specific jurisdiction in mind (e.g., a given state or city), thus the shadow prices used for that jurisdiction may not be appropriate for another.

The economic valuation of the effects of early intervention also need to account for the benefits or costs to different stakeholders in society. Typically, the stakeholders are divided into the government sector (i.e., individuals as taxpayers), program participants (as private individuals), and the rest of society (i.e., program non-participants as private individuals).[11] Table 4 illustrates how some of the potential benefits from early interventions would accrue across different stakeholders. Even though all the outcomes are specific to a participating parent, child, or the child's descendants, the positive benefits (or in some cases the negative benefits) may accrue to one or more stakeholders. There are economic effects (benefits, positive and sometimes negative) for the public sector from all but one of the outcome changes listed in Table 4. These benefits come in the form of reduced (or increased) costs for publicly provided services (e.g., education, child welfare, criminal justice) or changes in taxes and transfers (e.g., from changes in earnings or welfare use). Participants are also listed as beneficiaries (or losers) in Table 4 for many of the same outcomes, and even when they are not listed there may be psychic or intangible positive benefits (or negative benefits) that are typically not taken into account. For example, in addition to the savings to the public education system from reducing special education use, there may be a psychic benefit to the child or parent from being in regular education classes, rather than in special education. Finally, the one outcome that most clearly can have private effects on non-participants is changes in crime, as non-participants are potential crime victims with associated tangible and intangible economic consequences.

The issue of which outcomes to value, the economic value to use for those that are measured, and the disaggregation of economic values by the stakeholder are especially challenging issues for BCAs of early interventions because so many outcomes are not observed in the market and many affect multiple stakeholders and have both tangible and intangible components. How these issues are addressed in the application of the BCA methodology may have implications for whether a given program passes a benefit-cost test or shows a higher economic value compared with other early interventions or other policy options.

[11] Further disaggregation with these general categories of stakeholders is possible, such as different agencies within the government or different generations within the group of program participants (e.g., children versus parents).

Table 4 – Potential Benefits (Positive or Negative) of Improved Outcomes from Early Childhood Intervention Programs.

Whose Outcome Changes					Stakeholder		
Parent(s) of participant	Participating child	Descendent(s) of participant	Outcome Affected	Positive Benefits (Negative Benefits)	Government	Participants	Rest of society
X			Increased child care	Value of subsidized child care for parents of participating children		X	
	X	X	Reduced child maltreatment	Lower costs to child welfare system and lower abuse victim costs	X	X	
	X	X	Reduced child accidents and injuries	Lower costs for emergency room visits and other public health care costs	X	X	
	X	X	Reduced incidence of teen childbearing	Lower costs for public health care system and social welfare programs	X		
	X	X	Reduced grade repetition	Fewer years spent in K-12 education	X		
	X	X	Reduced use of special education	Lower costs for special education	X		
X	X	X	Increased high school graduation rate	(More years spent in K-12 education when dropping out is avoided)	(X)		
X	X	X	Increased college attendance rate	(More years spent in post-secondary education)	(X)	(X)	
X	X	X	Increased labor force participation and earnings in adulthood	Increased lifetime earnings for participants (net of taxes) and increased tax revenue to government	X	X	

Table 4 – Continued.

Whose Outcome Changes					Stakeholder		
Parent(s) of participant	Participating child	Descendent(s) of participant	Outcome Affected	Positive Benefits (Negative Benefits)	Government	Participants	Rest of society
X	X	X	Reduced use of welfare and other means-tested programs	Reduced administrative costs for social welfare programs; reduced welfare program transfer payments	X	(X)	
X	X	X	Reduced crime and contact with criminal justice system	Lower costs for criminal justice systems and lower crime victim costs	X		X
X	X	X	Reduced incidence of smoking and substance abuse	Lower costs for public health care system and from premature death	X	X	
X	X	X	Improved pregnancy outcomes	Lower medical costs due to low birth weight babies	X		

NOTES: Parentheses denote costs as opposed to benefits.
SOURCE: Based on Karoly, Kilburn, and Cannon (2005), Table 4.1.

Standardizing other BCA methods to support comparability

If BCAs for early childhood interventions are to go beyond the "proof-of-principle" and be used for comparative purposes, there is a need to standardize other aspects of the BCA methodology listed in the blue box in Figure 1, beyond the methods for projecting outcomes, valuing outcomes, and disaggregating values by stakeholders as already discussed. These issues include the discount rate or rates to use, the age (or time point) to discount to, accounting for scale-up effects, addressing uncertainty, and performing sensitivity analyses.

The appropriate discount rate to use is not unique to BCAs of early childhood interventions. However, the time point that costs and benefits should be discounted is a more distinctive concern to the early childhood context. That is because early intervention programs may start at different ages of the child, from before birth up to age 5 years. If discounting is taking to the age when a program starts, some BCAs will be discounting to birth (or earlier), whereas others will discount as late as age 4 years. When the discounting applies to different points in the lifecycle, the BCA measures of present value costs, benefits, and net benefits will not be comparable.[12] If the choice is between investing in a program at birth or waiting until age 4 years, all costs and benefits should be equated to a common age.

Of the other issues listed above, the concern about scale-up effects is particularly relevant for the early childhood field because many programs that have been evaluated were implemented as a demonstration project or on an otherwise limited scale. Yet, in many cases, the purpose of conducting a BCA is to inform policymakers who are considering a larger-scale implementation of the program. Typically, the expectation is that a larger-scale program may have diminished effects relative to a small-scale program. This might hold if larger-scale implementation means a loss of fidelity to the proven model or a reduction in quality because sufficient funding is not available. Alternatively, larger-scale implementation of a program may amplify the effects found at a smaller scale if there are synergies when a program covers a larger share of the population. For example, if there are positive (or negative) externalities or spillovers of early intervention for the peers of program participants when they are in K-12 education, having larger-scale implementation of an early childhood program could lead to a realization of those benefits that otherwise might not appear when only a few children have access to the program.

The need to address uncertainty and perform sensitivity analyses are two other salient issues for the use of BCA for early childhood programs. One source

[12] The benefit-cost ratio and internal rate of return (IRR) will be the same regardless of the age reference point for discounting, provided both costs and benefits are discounted to the same age.

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of uncertainty is that program effects on various outcomes are based on estimates derived from study samples, which results in sampling variability. Statistical uncertainty may also arise from the use of other model-based parameters such as projecting future benefits based on observed outcomes. Sensitivity analysis is relevant for determining whether the myriad number of choices regarding methods is critical for obtaining the results under the preferred set of methods. Sensitivity analyses can account for the choice of outcomes to value, whether outcomes are projected, the values applied, the application of scale-up factors, and other basic BCA methods such as the discount rate to use.

Addressing challenges in practice

This discussion has served to highlight several challenges with the application of the BCA methodology to early childhood interventions. In practice, the field has yet to coalesce around a common set of methods to ensure as much comparability as possible across the various BCAs. To illustrate the lack of standardization, Tables 5 and 6 summarize key method choices made in the BCAs listed in Table 2. Table 5 features some of the general issues, whereas Table 6 puts a spotlight on the valuation of outcomes. Although a total of 14 BCAs for early intervention programs are listed in Tables 5 and 6 (some conducted for the same program by different research teams or with differing amounts of follow-up data), several of the BCAs were performed as part of the same study using a common set of methods. For example, Aos et al. (2004) use the same BCA methods for the five programs or program types listed in Tables 5 and 6. Likewise, Karoly et al. (1998) use a common approach for the BCA of NFP and Perry Preschool, and Reynolds et al. (2002, 2011) use similar, although not identical, methods for their BCA of Chicago CPC based on two rounds of follow-up data. Finally, three of the BCAs for Perry Preschool conducted by different configurations of authors associated with that program's evaluation team apply a very similar approach to the follow-up data collected at ages 19, 27, and 40 years (Heckman et al., 2010, is not included in this group). Thus, effectively there are six different approaches applied in the 14 BCAs.

A comparison of the key elements of the methods used can be summarized as follows:

- *Discount rate*. With the exception of the Aos et al. (2004) study and the age-19 Perry Preschool BCA by Berrueta-Clement et al. (1984), a range of discount rates is employed, with 3% or 4% selected as the preferred rate (see Table 5). Aos et al. (2004) and Berrueta-Clement et al. (1984) both use 3% as the sole discount rate.

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Table 5 – General Methods in BCAs for Early Childhood Interventions.

BCA Study / Program	Age at Intervention Start	Age at Last Follow-Up	BCA Discount Rate(s) (%)	BCA Discounts to Age	BCA Dollar Year	BCA Has Stakeholder Disaggregation?	BCA Reports Standard Errors?	BCA Reports Sensitivity Analyses?
Aos et al. (2004) / NFP	Up to 30th week of gestation	15	3	0	2003	Yes	No	To outcomes valued
Aos et al. (2004) / IHDP	Birth	8	3	0	2003	Yes	No	To outcomes valued
Aos et al. (2004) / HIPPY USA	3 to 4 years	6	3	3	2003	Yes	No	To outcomes valued
Aos et al. (2004) / Home visiting (meta)	Varies (*in utero* min.)	Varies (age 15 max.)	3	0	2003	Yes	No	To outcomes valued
Aos et al. (2004) / Early childhood education (meta)	Varies (age 3 min.)	Varies (age 27 max.)	3	3	2003	Yes	No	To outcomes valued
Karoly et al. (1998) / NFP	Up to 30th week of gestation	15	4, 0–8	0	1996	Yes	For $ savings to government	To discount rate, outcomes valued
Karoly et al. (1998) / Perry Preschool	3 to 4 years	27	4, 0–8	0	1996	Yes	For $ savings to government	To discount rate, outcomes valued
Masse and Barnett (2002), Barnett and Masse (2007) / Abecedarian	6 weeks to 3 months	21	0, 3, 5, 7, 10	0	2002	No	No	To discount rate, outcomes valued
Reynolds et al. (2002) / Chicago CPC	3 to 4 years	21	3, 0–7	3	1998	Yes	No	To discount rate, outcomes valued, projection method
Reynolds et al. (2011) / Chicago CPC	3 to 4 years	26	3, 0–7	3	2007	Yes	Yes	To discount rate, outcomes valued, projection method

Table 5 – continued.

BCA Study / Program	Age at Intervention Start	Age at Last Follow-Up	BCA Discount Rate(s) (%)	BCA Discounts to Age	BCA Dollar Year	BCA Has Stakeholder Disaggregation?	BCA Reports Standard Errors?	BCA Reports Sensitivity Analyses?
Berrueta-Clement et al. (1984) / Perry Preschool	3 to 4 years	19	3	3	1981	No[a]	For $ benefits by stakeholder	To outcomes valued
Barnett (1993, 1996), Schweinhart, Barnes, and Weikart (1993) / Perry Preschool	3 to 4 years	27	3, 5, 7, 9. 10, 11	3	1992	No[a]	No	To discount rate, outcomes valued, projection method
Barnett et al. (2005), Nores et al. (2005), Belfield et al. (2006) / Perry Preschool	3 to 4 years	40	0, 3, 7	3	2000	No[a]	No	To discount rate, outcomes valued, projection method
Heckman et al. (2010) / Perry Preschool	3 to 4 years	40	0, 3, 5, 7	3	2006	Yes	Yes	To discount rate, outcomes valued, cost of crime, projection method

[a]Benefits for taxpayers (i.e., the government) are not separated from private benefits to non-participants (e.g., crime victims).
SOURCE: Based on Karoly, Kilburn, and Cannon (2005), Tables 2.4 and 4.2, and the cited sources.

Table 6 – Valuation of Outcomes in BCAs for Early Childhood Interventions.

BCA Study / Program	Outcomes Observed and Valued	Outcomes Observed But Not Valued	Outcomes Projected in Time	Outcomes Projected for Third Parties?	Value Parent Time?	Value Intangible Crime Benefits?
Aos et al. (2004) / NFP	• Child abuse and neglect • Achievement tests • Crime (mother and child)	• Emergency room use • Earnings (and taxes) • Welfare use (mother) • Total births and birth spacing (mother) • Substance abuse (mother)	• Child abuse and neglect • Earnings (and taxes) • Crime (mother and child)	No	No	Yes
Aos et al. (2004) / IHDP	None	• Achievement tests • IQ scores • Mother-child interactions • Home environment	None	No	No	n.a.
Aos et al. (2004) / HIPPY USA	• Achievement tests	None	• Earnings (and taxes)	No	No	Yes
Aos et al. (2004) / Home visiting (meta)	• Child abuse and neglect • Achievement tests	• Contraceptive use (mother)	• Child abuse and neglect • Achievement tests	No	No	Yes
Aos et al. (2004) / Early childhood education (meta)	• Child abuse and neglect • Achievement tests • K-12 net savings • High school graduation • Crime	None	• Child abuse and neglect • Earnings (and taxes) • Crime	No	Value child care benefit for parents	Yes
Karoly et al. (1998) / NFP	• Emergency room use • Earnings (and taxes) (mother) • Crime (mother and child) • Welfare use (mother)	• Child abuse and neglect • Achievement tests • Total births and birth spacing (mother) • Substance abuse (mother)	• Crime (child)	No	No	No
Karoly et al. (1998) / Perry Preschool	• K-12, college and adult education net savings • Earnings (and taxes) • Crime • Welfare use	• Academic success • Teen pregnancy	• Earnings (and taxes) • Crime • Welfare use	No	Value child care benefit for parents	No

Table 6 – continued.

BCA Study / Program	Outcomes Observed and Valued	Outcomes Observed But Not Valued	Outcomes Projected in Time	Outcomes Projected for Third Parties?	Value Parent Time?	Value Intangible Crime Benefits?
Masse and Barnett (2002), Barnett and Masse (2007) / Abecedarian	• K-12 net savings • Educational attainment • Smoking • Welfare use • Earnings (mother)	None	• College costs • Earnings (and taxes) • Mortality • Welfare use • Earnings (mother)	Earnings of descendents (three generations)	Value child care benefit for parents	n.a.
Reynolds et al. (2002) / Chicago CPC	• Child abuse and neglect • K-12 net savings • Crime	None	• College costs • Earnings (and taxes) • Crime	No	Value (a) required parent time in centers; (b) child care benefit for parents	No
Reynolds et al. (2011) / Chicago CPC	• Child abuse and neglect • K-12 and college net savings • Crime • Depression • Substance use • Smoking	None	• Child abuse and neglect (intangible victim costs) • Earnings (and taxes) • Crime • Depression • Substance use • Smoking	No	Value (a) required parent time in centers; (b) child care benefit for parents	Yes

Table 6 – continued.

BCA Study / Program	Outcomes Observed and Valued	Outcomes Observed But Not Valued	Outcomes Projected in Time	Outcomes Projected for Third Parties?	Value Parent Time?	Value Intangible Crime Benefits?
Berrueta-Clement et al. (1984) / Perry Preschool	• K-12 net savings • Earnings (and taxes) • Crime • Welfare use	• Academic success • Teen pregnancy	• College costs • Earnings (and taxes) • Crime • Welfare use	No	Value child care benefit for parents	Unclear
Barnett (1993, 1996), Schweinhart, Barnes, and Weikart (1993) / Perry Preschool	• K-12, college and adult education net savings • Earnings (and taxes) • Crime • Welfare use	• Academic success • Teen pregnancy	• Earnings (and taxes) • Crime • Welfare use	No	Value child care benefit for parents	Yes
Barnett et al. (2005), Nores et al. (2005), Belfield et al. (2006) / Perry Preschool	• K-12, college and adult education net savings • Earnings (and taxes) • Crime • Welfare use	• Academic success • Mortality (intrinsic value of loss of life)	• Earnings (and taxes) • Crime • Welfare use	No	Value child care benefit for parents	Yes
Heckman et al. (2010) / Perry Preschool	• K-12, college and adult education net savings • Earnings (and taxes) • Crime • Welfare use	• Academic success • Mortality (intrinsic value of loss of life)	• Earnings (and taxes) • Crime • Welfare use	No	No	Yes

SOURCE: Based on Karoly, Kilburn, and Cannon (2005), Table 4.3, and the cited sources.
NOTE: All outcomes pertain to the participating child unless otherwise noted.
n.a. = not applicable.

- *Age discount to*. Karoly et al. (1998) is the only study to apply a common age to discount to (in this case the child's birth), regardless of the age of entry into the program (see Table 5). The other BCAs using the age at entry which is either effectively birth or age 3 years.
- *Stakeholder disaggregation*. With the exception of the BCAs for Abecedarian and the three related BCAs for Perry Preschool, all the BCAs present results disaggregated for the public sector (government or taxpayers), participants, and the rest of society (see Table 5).
- *Accounting for uncertainty*. With four exceptions, the BCAs do not account for uncertainty in the BCA results by reporting standard errors (see Table 5). In two of the cases where standard errors are reported (Berrueta-Clement et al., 1984; Karoly et al., 1998), they only apply to a portion of the BCA results (the dollar savings to government in the former and the dollar benefits by the stakeholder in the latter). Reynolds et al. (2011) report standard errors for all cost and benefit dollar estimates and benefit-cost ratios for each stakeholder, whereas Heckman et al. (2010) provide standard errors estimated benefit-cost ratios and internal rates of return.[13]
- *Performing sensitivity analyses*. Sensitivity analyses are primarily limited to two types (see Table 5). All the methods report the disaggregated estimates of benefits by outcome valued, so that it is possible to determine which outcomes are relatively more or less important drivers of the estimated benefits. The use of alternative discount rates in all but two studies can also be viewed as a type of sensitivity analysis. Four of the study groups also examine the sensitivity of results to the method for projecting future benefits, primarily future earnings. Heckman et al. (2010) is the only study to also present sensitivity analyses associated with different values for the social cost of crime.
- *Outcomes valued*. For programs with follow-up only to the early elementary grades (i.e., HIPPY USA at age 6 years and IHDP at age 8 years), at most the effects on achievement tests are valued in dollar terms (see Table 6). For the IHDP program, Aos et al. (2004) discount the effect size to zero and thus no outcomes are valued. The other

[13] The standard errors account for different sources of uncertainty and are estimated using different approaches. For example, among the two recent studies, Reynolds et al. (2011) account for the uncertainty in the estimated program impacts, both by monetizing the standard errors associated with each impact estimate and by Monte Carlo simulation assuming a normal distribution of program effect sizes. Heckman et al. (2010) use a combination of bootstrap resampling and Monte Carlo simulation to account for both errors in estimation and in prediction. Both studies assess the impact of other sources of uncertainty through sensitivity analyses.

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BCAs have access to follow-up data through at least age 15 years and as late as age 40 years. The most common outcomes valued are child abuse and neglect, K-12 education savings, earnings, welfare use, and crime.

- *Outcomes not valued*. For several of the BCAs, the early intervention programs had statistically significant effects on outcomes that were not valued (see Table 6). Some of these outcomes such as achievement test scores, child abuse and neglect, and substance use were valued in other BCAs. For the Aos et al. (2004) approach, for example, program effects were adjusted to account for the scale of the intervention and other concerns, thus the adjustments often resulted in the outcome not being valued at all. Several outcomes were not valued in any of the studies, notably because they do not have ready shadow prices. These include IQ scores, mother-child interactions, the home environment, contraceptive use, total births and birth spacing, and teen pregnancy.
- *Outcomes projected*. For each of the studies that valued observed outcomes, at least one outcome was also projected beyond the last follow-up and valued in the BCA (see Table 6). The most common outcomes projected were college costs, earnings (sometimes based on test scores or educational attainment), welfare use, and crime. Based on observed child abuse and neglect, the Aos et al. (2004) approach also projected and valued future outcomes in terms of crime, high school graduation, K-12 grade repetition and test scores, alcohol use, and illicit drug use. The Abecedarian and age-26 Chicago CPC BCAs projected future mortality based on smoking rates observed at the last follow-up, and the long-term costs of depression were also projected in the same Chicago CPC BCA. The Abecedarian BCA was also the only analysis to project and value future earnings for descendents of program participants.
- *Valuing participant time*. For programs that included parent participation, only the BCA for Chicago CPC by Reynolds et al. (2002, 2011) valued the time costs for parents (see Table 6). In the other BCAs, the argument was made that parental time spent in home visits and other activities was usually voluntary, so that if parents chose to participate, there must have been intrinsic benefits that outweighed the cost of their time. The BCAs for all but two of the center-based early childhood programs [the IHDP BCA and the Heckman et al. (2010) Perry BCA are the exceptions] also included the value of the childcare benefits parents received.
- *Valuing intangible crime benefits*. Table 6 does not summarize differences in the shadow prices applied to the outcomes that were

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valued. However, one potentially important choice is whether to account for the intangible benefits to potential victims of reductions in crime, as the dollar amounts from such benefits can be large. Table 6 shows that some BCAs opt to exclude these intangible benefits to generate more conservative estimates, whereas others include them.

This summary demonstrates that there is convergence on some elements of the BCA methodology used for early childhood programs, but other elements are a source of variation that limits the comparability of BCA results across studies. Usually with at most one exception, the studies use and report alternative discount rates, include stakeholder disaggregation, value childcare benefits, and project a common set of outcomes. There is less standardization in the age to which costs and benefits are discounted, in accounting for uncertainty by reporting standard errors, in performing a range of sensitivity analyses, in valuing a common set of outcomes, and whether to incorporate the intangible costs of crime. Another source of variation that has not been discussed in detail here, but will be taken up in the next section, is the actual economic values or shadow prices attached to each outcome.

TOWARD STANDARDIZATION OF BCAs FOR EARLY CHILDHOOD INTERVENTIONS

In the above section, the review of BCAs for early childhood interventions as practiced highlights the need for standards to bring more uniformity and comparability to BCAs in this field. As noted, there is greater comparability regarding the application of some elements of the BCA methodology to early childhood interventions, such as the discount rate to use and disaggregation of results by the stakeholder. These and some other elements are most readily standardized, thus I discuss them first. The greatest variation in practice concerns which outcomes, either observed or projected, to value and the values to attach. Although complete standardization may not be possible, I discuss the potential for movement in this direction. I then discuss sensitivity analyses as a principle for BCA of early intervention programs that also contributes to greater standardization in methods. Moreover, sensitivity analyses can help address the lack of standardization on other elements of the methodology. Finally, I suggest some standards for reporting BCA methods and results to ensure greater transparency. Table 7 provides a summary of the cumulative set of recommendations.

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Table 7 – Recommended Standards for BCAs of Early Intervention Programs.

BCA Methodology Element	Recommendation
Discount rate	Use 3% as the standard real discount rate but report results using alternative discount rates as part of the sensitivity analyses (see below)
Age discount to	Discount costs and benefits to the focal child's birth but report results for at least age 5 years as part of the sensitivity analysis (see below) to support comparison with school-age programs
Stakeholder disaggregation	Disaggregate costs and benefits for key stakeholders, which at a minimum includes government, participants, and the rest of society
Accounting for uncertainty	Report standard errors accounting for sampling error; account for non-sampling error (e.g., model uncertainty associated with projections or other modeling) and other sources of uncertainty (e.g., program scale-up) through sensitivity analyses (see below)
Valuing program costs	• Calculate the full economic costs of the incremental resources used for the program group versus the no program group, accounting for goods and services provided in-kind • Any induced costs (e.g., remaining in school longer) should be treated as negative benefits and not as additional program costs
Outcomes to value, shadow prices, and projections	• Value all the outcomes available for all relevant parties, including participating children and their parents, siblings, and peers • Use economic values that capture the willingness to pay concept • Where intangible costs or benefits are involved, develop shadow prices to account separately for both tangible and intangible components and generate estimates of both types of dollar benefits (or costs) • Account for the value of participant time spent in the program, especially if participation is mandatory and not voluntary
Performing sensitivity analyses	Conduct a range of sensitivity analyses that provide, at a minimum: • Results for alternative discount rates (e.g., 0%, 5%, 7%, and 10%) • Results for alternative ages to discount to (e.g., age 3 years, age 5 years) • Results for alternative shadow prices (e.g., with and without intangible crime costs) • Results for alternative approaches to future projection When relevant, also include: • Results for different assumptions about the effects of program scale-up • Results based on reduced information, such as data from later follow-ups or for specific outcomes, to mirror what is available for BCAs of other programs • Results based on alternative distributional assumptions

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Table 7 – continued.

BCA Methodology Element	Recommendation
Reporting results	Be transparent in reporting key features of the evaluation and BCA methodology and results, including: • The baseline or status quo that the program is compared to • The evaluation method, the program impacts and their statistical significance, potential biases in estimates of causal effects, and any adjustments to estimated program impacts • Which outcomes measured in the evaluation are valued in the BCA and which are not valued • Which outcomes are observed versus projected, for whom they are projected, and the projection method • For the outcomes valued, the valuation used, its derivation, and the geographic or jurisdictional boundary the valuation applies to • The method for estimating program costs and any omitted resources, including in-kind goods and services • The calendar year for all dollar amounts, discount rate, and age discounted to • Aggregate results for present discounted value societal costs, benefits, and net benefits and the benefit-cost ratio; use appropriate adjustments if reporting the internal rate of return • The present discounted value benefits (or costs) of each outcome valued, with a disaggregation by outcomes observed versus projected and disaggregation, where possible and relevant, by tangible versus intangible benefits (e.g., for crime or child abuse and neglect) • Disaggregated present discounted value costs and benefits in total and by outcome valued for the key stakeholders defined above • The estimated standard errors, at least in aggregate, for present discount value costs (if relevant) and benefits • The results of any sensitivity analyses

Discount rates and discounting age

In practice, there is no agreed upon discount rate to use in BCAs more generally or specifically for early intervention programs. Candidates for the social discount rate may be based on the social marginal rate of time preference, the marginal rate of return on private investments, the social opportunity costs of public sector investment, or the shadow price of capital (Boardman and Greenberg, 1998; US Government Accountability Office, 1991). The social discount rates may vary through time and may even be zero or negative when benefits occur far in the future or when society values the well-being of future generations more highly than the current generation (Boardman and Greenberg, 1998; Dasgupta, Mäler,

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and Barrett, 2000). For convenience, however, discount rates are almost always assumed to be constant. Variation in the rate is provided for in US Government Accountability Office (GAO) guidelines, which recommend a base case that applies the real yield on US treasuries with maturity consistent with the time horizon of the project being evaluated, combined with sensitivity analysis to alternative rates (US Government Accountability Office, 1991). Constant real discount rates of 3% and 5% are recommended in medicine (Gold et al., 1996). Moore et al. (2004) suggest a 3.5% social discount rate for government projects that are intragenerational (i.e., do not last beyond 50 years) and there is no crowding out of private investment. The Office of Management and Budget (OMB) guidelines favor a real discount rate of 7%, "the approximate pre-tax rate of return on an average investment in the private sector in recent years" (Office of Management and Budget, 1992), whereas the Congressional Budget Office typically applies a 2% real discount rate, an approximation of the long-run average annual borrowing costs for the federal government (Hartman, 1990).

The most common preferred discount rate employed in the BCAs of early childhood programs listed in Table 5 was 3%, a rate that is within the range of the recommended rates cited above. Among the studies cited in Table 5, it was also routine to report results for a range of rates as part of a sensitivity analysis. This approach is reasonable and the practice should be adopted as the standard. Thus, a 3% real discount rate can be used for baseline results and then results can also be presented for alternative rates such as 0%, 5%, 7%, or 10%, where the rates at the low end are potentially appropriate given the long horizon over which the benefits from early intervention may accrue. Moreover, providing results for a range of discount rates can be used to see how high the discount rate can go before net benefits are zero (or how low it must go before net benefits are positive).

As noted earlier, although it may be standard to discount benefits and costs to the start of the program of interest, in the context of early interventions, this can mean that discounting is made to different ages during the first 5 years of life. Thus, to ensure greater comparability of BCA results – notably measures of present value costs, benefits, and net benefits – across early childhood programs, discounting should be made to one or more common ages. The birth of the focal child is a natural measurement point, as the decision-maker's problem is whether to start investing as early as birth or to defer an investment until later in the period before children enter school.[14] A dollar spent on a program that started at birth could be invested instead and used to pay for a more expensive program that

[14] A case could be made that conception is the appropriate reference point, as some early childhood interventions begin before birth. The choice of birth as the reference point is offered for expediency, expecting that results will not be that sensitive to accounting for the 40-week potential gestational period.

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began at age 2 or 3 years, for example. Thus, a fair benefit-cost comparison across programs with different investment profiles requires discounting to a common age. Of course, standardization could occur at any age and there are reasons to consider additional ages for purposes of reporting. Thus, for example, discounting to age 5 years would allow comparisons with programs that begin in kindergarten or other school-age programs if they are also discounted to the same age.

Stakeholder disaggregation

Depending on the perspective of the decision-maker, there may be an interest in benefits and costs of early childhood interventions from the perspective of society as a whole or from the perspective of specific stakeholders, such as the public sector or private program participants. Thus, it is common in BCAs to report results disaggregated by the stakeholder, in addition to the societal perspective. At a minimum, the stakeholders in the disaggregation should include government, program participants, and the rest of society. The government sector could be further disaggregated by jurisdiction (e.g., federal, state, and local) and private benefits could be calculated for subcategories of participants (e.g., focal child, parents, siblings, descendants).

Accounting for uncertainty

Although it is not typically done in the early childhood intervention application, BCAs should recognize the uncertainty associated with estimates of costs and benefits (see also Vining and Weimer, 2009, 2010, for a discussion of this issue and the application of Monte Carlo methods). First, there is the statistical uncertainty associated with sampling error because program impacts are estimated using a sample-based evaluation. An evaluation with a smaller sample size will produce estimates of program impacts with larger error bands, and that higher degree of uncertainty should be reflected in the standard errors associated with the estimates of present value costs and benefits. Reporting standard errors also addresses the concern as to whether outcomes for which there is a statistically non-significant program impact should be valued.

Of the BCAs reported in Tables 5 and 6, sometimes only outcomes with statistically significant impacts are valued in the BCA, whereas others also value outcomes with non-significant effects. The lack of statistical significance may result from small samples, which give low power for detecting program impacts with magnitudes that would produce meaningful dollar benefits or cost. Rather than assuming effects and dollar benefits are zero based on the standard errors, the statistically non-significant evaluation impacts can be included in the calculation of benefits and costs, but the greater degree of statistical uncertainty will be

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reflected in the size of the standard errors (Vining and Weimer, 2009, 2010). In addition, as recommended below as part of transparency in reporting, by presenting the statistical significance of all program impacts and the present discounted values disaggregated by the outcomes valued, it is possible to determine if the BCA results are sensitive to the inclusion or exclusion of outcomes that are not statistically significant. The Heckman et al. (2010) BCA of Perry Preschool and the Reynolds et al. (2011) BCA of Chicago CPC are exemplary in generating standard errors for the key BCA summary outcomes reported [e.g., costs, benefits, net benefits, benefit-cost ratios, or internal rate of returns (IRRs)], as well as reporting the statistical significance of the program impacts and the present value estimates disaggregated by outcome.

Other sources of uncertainty, non-sampling error, can be associated with having to estimate the various parameters used to calculate costs and benefits, such as shadow prices or projected future benefits. Another source of uncertainty is whether the costs and program effects estimated for a smaller scale or demonstration program will be replicated when the program is implemented at a larger scale. As noted earlier, such scale-up effects could lead to effects that are diminished or amplified, and there may be little basis for knowing the direction or magnitude of the scaling factor. The implications of these various sources of non-sampling error can be examined through the types of sensitivity analyses, discussed below, that can determine how robust results are to alternative modeling assumptions and parameter estimates.

Valuing program costs

The valuation of program costs relative to the baseline or alternative should be as rigorous as the valuation of the program benefits, with a full accounting of the economic costs associated with the delivery of the program. Ideally, this means collecting costs data prospectively, as the program is delivered, using the RCM approach to capture the quantities of resources used so the appropriate valuations can be applied. Any resources that are not accounted for or valued should be noted as part of the reporting of the BCA methodology and results, as discussed below.

Outcomes to value, shadow prices, and projections

Across the BCAs for early childhood interventions summarized in Tables 5 and 6, there is variation in the outcomes that are valued, as well as the economic values attached to those outcomes that are included in the calculations. At the same time, given the nature of the potential for lasting effects of early interventions, all the BCAs reviewed above projected at least one outcome into the future, often based

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on a different observed outcome (e.g., achievement scores during the K-12 years are used to project future earnings).

In principle, all outcomes in both the short and long run affected by the program for all relevant parties should be valued in the BCA, whether those outcomes produce benefits or costs to the various stakeholders. The parties could include the focal child, the participating parent(s), the child's siblings, and even their peers. The application of this principle in practice for any given early childhood intervention is limited by the outcomes actually measured in the evaluation, who the outcomes are measured for, and the length of the follow-up period over which outcomes are observed. Moreover, comparability across the BCAs for different programs would require that all evaluations measure the same outcomes, using the same measures, for the same parties, and over the same time period. Although such standardization does not characterize the evaluations of early childhood interventions to date, it may be more feasible in the future if research teams coordinate their evaluation efforts to ensure greater comparability.

Given current limitations in the standardization of evaluation methods, greater standardization could be applied to the economic values or shadow prices attached to the available outcomes. Although it is not feasible in this paper to make recommendations regarding specific shadow prices to employ for all possible outcomes affected by early intervention programs at a national level or for more disaggregated geographic locales, I do offer recommendations regarding several of the more generic issues that arise in valuing outcomes from early intervention.[15]

Given the nature of many of the outcomes affected by early intervention, one of those issues is whether both tangible and intangible benefits or costs should be incorporated into the shadow price. For example, as noted earlier, when crime is reduced, the potential victims of crime experience the tangible benefit of not having the property loss or medical costs from injuries, as well as the intangible benefits of reduced pain and suffering. Intangible benefits may also apply to program participants, such as the psychic benefit a child or parent would receive when the child performs better in school. Intangible benefits may also accrue to the rest of society beyond program participants, such as having improved educational outcomes for children, a reduction in welfare, or a more equal distribution of income.

In principle, such intangible benefits should be incorporated into the shadow price in the same way that tangible benefits are included. In practice, as

[15] See Karoly (2008) for additional detail on the shadow prices used for BCAs of early intervention programs and other social programs. Vining and Weimer (2009, 2010) also discuss the need for better shadow prices to use in BCAs of social programs, many of which are relevant to the application of BCAs for early childhood programs.

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shown in Table 6, BCAs for early childhood interventions have both included and excluded intangible crime benefits. The challenge in practice is that such intangible benefits are more difficult to quantify, hence there is often more controversy with the methods used to estimate intangible benefits and in the resulting estimates. For example, the available estimates of the intangible benefits from reductions in crime, especially some types of crime such as murder or other violent crimes, are typically several times larger than the tangible benefits (see, for example, Miller, Cohen, and Wiersema, 1996, and Miller, Fisher, and Cohen, 2001). Consequently, the intangible crime benefits can account for a substantial share of the estimated benefits for a given early intervention program (Barnett et al., 2005; Nores et al., 2005; Belfield et al., 2006). For this reason, I recommend separate reporting of the present value benefits for tangible and intangible components of a given outcome's value, so the contribution of each to total benefits is clear.

As many early intervention programs work directly with parents, another valuation issue is whether to account for the opportunity cost of parents' time. As noted earlier, the BCAs to date summarized in Tables 5 and 6 have made a distinction between parent participation that is voluntary (e.g., time spent with a home visitor or in a parenting workshop) versus parent participation that is mandatory (i.e., a requirement to spend time in the child's classroom). No value is placed on parent time in the first instance, as voluntary participation implies non-pecuniary benefits to the parent that at least equal the opportunity cost of their time. When participation is required, that assumption may no longer be valid.[16] In practice, the full opportunity cost of time has been used even though parents may still derive intrinsic benefits that may offset at least some of the value of their time. I recommend that this approach be continued, although the value of parent time should be reported separately so that a sensitivity analysis is possible.

Finally, because many of the benefits of early childhood interventions have the potential for long-lasting effects, BCAs for early childhood interventions typically project at least one outcome beyond the age of the last follow-up. Of the BCAs listed in Tables 5 and 6, there is variation in the projection method adopted for the common outcomes projected such as earnings, crime, and welfare use. Greater standardization could be applied to the methods used to project these and other outcomes, although one challenge to such standardization is the age from which projections are made often vary across BCAs because of variation in the age at the last follow-up. Thus, it may be possible to standardize on the nature of the modeling assumptions made, even if the specific projections made vary with the starting age.

[16] See Vining and Weimer (2009, 2010) for additional discussion of this issue.

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Performing sensitivity analyses

Sensitivity analyses can be used to examine the implications for BCA results of making alternative choices regarding various benefit-cost methods. In areas where there is no clear consensus about the methods or parameters to use (e.g., shadow prices), sensitivity analyses can illuminate the importance of the choices made in the preferred or baseline methods. At a minimum, I recommend sensitivity analyses to examine the effects of employing alternative discount rates, discounting to alternative ages, using different shadow price estimates, and adopting alternative methods for projecting future outcomes. When there are concerns about the effects of program scale-up on program costs and effects, sensitivity analyses can also be performed using different scaling factors.

Sensitivity analyses can also be used to estimate comparable benefit-cost results when programs have different follow-up periods or measure different outcomes. For example, if program A had a shorter follow-up period or measured fewer outcomes than program B, the BCA for program B can be recalculated to match that for program A, using only data through the same age as the last follow-up in program A and for the same outcome measures. In effect, to achieve comparability, this approach assumes that program B has less information available about longer-term effects or effects on a wider range of outcomes than in reality, so that the BCA for program B is based only on the information that is comparable to what is available for program A.

Finally, alternative distributional assumptions can be explored as part of the sensitivity analyses. Although the BCAs for early interventions reviewed earlier in the paper have not applied alternative distributional weights (i.e., each dollar of benefits or costs are weighted equally regardless of individual characteristics such as income or wealth), such weights can be applied and the implications reported as part of the sensitivity analyses.

Transparency in reporting

Standardization of methods in the application of BCA to early childhood interventions will provide a foundation for sound policy analysis, yet that foundation will be compromised if results are not reported in a way that the research and policy communities can understand and discern the methods choices applied and how they vary across studies. Thus, transparency in reporting is key to ensuring that the results of BCAs are used at all and used appropriately. In this final section, I highlight key aspects of the underlying program evaluation and the BCA methodology and results that should be incorporated into the reporting of BCAs for early childhood programs.

Program evaluation methods

Details of the evaluation of the early intervention program are often reported separately, so it is important to summarize key features that may affect the validity of the BCA or that provide relevant context. For example, the evaluation methods should be described and any potential biases should be identified, such as deviations from a well-implemented randomized experiment, issues in using a quasi-experimental approach, or attrition rates for studies with longitudinal data collection. Where possible, appropriate statistical methods should be used to remedy these problems, such as imputation for missing data and corrections for treatment-control crossovers.

The experience of control group members should be discussed, such as whether they received any services as part of the evaluation or if the *status quo* for control group members included services similar to those received by the treatment group. This serves to clarify what incremental services were received by the treatment group for which the causal effects were measured in the evaluation. Where possible, ITT estimates may be converted to TOT estimates so that cross-program comparisons are more valid. The estimated program effects and their statistical significance should be reported, along with any adjustments to estimate program impacts to adjust for potential biases in estimation, to convert from ITT to TOT estimates, or to account for other factors such as program scale-up.

BCA methods

The description of the BCA methods employed should make clear which of the outcomes affected by the program were valued in the BCA and which were not. Outcomes that were projected, for whom they were projected (e.g., participating children or parents or other third parties such as descendants, siblings, or peers), and the projection method should also be described. Another key element for disclosure is the economic values applied to each outcome, whether they are intended to capture either tangible or intangible benefits or both, and the geographic or jurisdictional boundaries (e.g., specific markets or levels of government) used to derive the values. The discussion should also delineate the method for collecting program cost data. Any omission of resources used and their associated valuation, whether or not they required cash outlays, should be identified. Other elements discussed above such as the discount rate, age discounted to, estimation of standard errors, approach to sensitivity analysis, and so on should also be made explicit.

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BCA results

In reporting BCA results, the year for dollar amounts should be stated. The reported BCA metrics should include the present discounted value societal costs, benefits, and net benefits (net present value), along with the benefit-cost ratio. Reliance on the IRR is problematic because of the well-known issues that the IRR may not be unique and will not necessarily rank projects in the same order as the net benefit metric will (Zerbe and Dively, 1974). A similar issue with respect to inconsistent rankings may also occur with the benefit-cost ratio when projects of a different size (i.e., cost) are compared. However, adjustments can be made to the benefit-cost ratio and IRR calculations that will then produce consistent rankings.[17]

In addition to presenting aggregates, disaggregated results should show estimates for each outcome valued and for the key stakeholders. Ideally, the estimates by program outcomes would differentiate dollar benefits (or costs) based on observed outcomes versus projected outcomes and, where possible and relevant, based on tangible versus intangible benefits (or costs). Presenting disaggregated results facilitates identifying which outcomes make relatively large or relatively small contributions to estimates of net benefits, determining of the effect of including or excluding benefits for program effects that were not statistically significant, and identifying whether specific stakeholders, in addition to society as a whole, are net beneficiaries. Finally, the estimated standard errors, at least in aggregate for present discounted value costs (if relevant) and benefits, and the results from any sensitivity analyses should also be reported.

CONCLUSION

Decision-makers in the public and private sectors considering investments in early intervention programs have gravitated towards BCA results which demonstrate that effective programs can also generate favorable economic returns. The BCA estimates reviewed in this paper, based on results published to date, suggest that early interventions can generate dollar benefits to society as a whole that exceed program costs. When there are effects on outcomes that can be valued, the BCAs show returns that range from approximately $2 to $16 for every dollar invested, results that are modest to sizeable compared with other social policy programs. However, the current practice with respect to BCA for early childhood programs does not ensure comparable results across different estimates. Thus, a program with a higher estimated net benefits or higher benefit-cost ratio does not necessarily have a higher return compared with a program that has a lower

[17] See, for example, Zerbe's (2010) proposed "reliable" internal rate of return (IRRr) and the discussion in Zerbe and Dively (1974) regarding adjusting for projects with different costs.

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estimate of net benefits or the benefit-cost ratio. That is because some of the differences in BCA estimates arise from different implementation of the BCA methodology, rather than true differences in economic returns.

To support greater standardization of BCA methods applied to early childhood interventions and to encourage greater transparency in reporting of the methods used, this paper has developed recommendations regarding standards that analysts can apply in practice. These recommendations concern issues such as the discount rate to use and the age to which costs and benefits should be discounted; stakeholder disaggregation; outcomes to value, the associated values, and projections of future outcomes; accounting for uncertainty; sensitivity analysis; and reporting of results. If these recommendations are embraced by those who conduct BCAs for early childhood programs, consumers of the BCAs will also benefit as they seek to make decisions regarding which programs to support and whether early intervention should receive greater investment relative to other uses of scarce resources.

However, even these recommendations will not ensure complete uniformity in the application of BCA to early childhood programs. The methods component where standardization is most problematic, given the current state of practice, is in the valuation of the outcomes affected by early intervention programs. As noted by Vining and Weimer (2009, 2010), the use of BCA for social policy more generally will benefit from the refinement of economic values for outcomes such as cognitive development, educational attainment, crime (specifically tangible and intangible victim crime costs, as well as the marginal cost of criminal justice system resources), and the opportunity cost of volunteer time.[18] For several of these outcomes, it is relevant to value observed outcomes and also to project benefits (or costs) into the future. Until researchers converge upon an agreed set of valuations for the key outcomes affected by early childhood programs, sensitivity analysis can be used to determine how robust BCA results are to the specific economic valuations and projection methods used. The use of sensitivity analysis, combined with the other recommendations offered in this paper, will help to advance the appropriate use of BCA in support of decision-making regarding investments in early childhood programs.

[18] See also National Research Council (NRC) and Institute of Medicine (IOM), 2009 for a discussion of approaches to valuing outcomes affected by early childhood interventions and projecting future outcomes based on observed results.

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