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Benefits and costs of investments in preschool education: Evidence from the Child–Parent Centers and related programs

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Abstract

We discuss the evidence on the effectiveness of preschool programs using results from three well-known intervention studies: the Chicago Child–Parent Centers, High/Scope Perry Preschool Program, and the Carolina Abecedarian Project. Results from cost–benefit analyses of other programs for younger and older children also are reported. Given that the Child–Parent Center Program is an established, large-scale preschool program for which a cost–benefit analysis has been recently completed, we focus on this program. We examine the longer-term effects in more detail and we investigate the robustness of estimates used in the cost–benefit analysis. Depending on the assumptions made, our results indicate that the benefit–cost ratio for the preschool program offered by the Child–Parent Centers ranges from $5.98–$10.15. We find strong evidence that the consistently positive economic returns of high-quality preschool programs exceed most other educational interventions, especially those that begin during the school-age years such as reduced class sizes in the elementary grades, grade retention, and youth job training.

JEL classification: I28; H43

Keywords: Human capital; Rate of return; Educational economics

1. Introduction

In recent years, policymakers and economists appear captivated by estimates suggesting a high rate of return to early childhood education. The first estimates came from the well-known High/Scope Perry Preschool Program (Barnett, 1985); and while early childhood advocates and policymakers frequently used these results to argue that preschool programs can yield sizeable benefits, there were two major drawbacks. Because the sample size was small and the educational intervention was a researcher-initiated model program, critics argued that it was not clear how these results might generalize to other non-model preschool programs such as those offered by financially constrained public schools or human service agencies. Moreover, until recently there existed no results from other cost–benefit studies of either large- or small-scale early childhood

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programs to offer corroborating evidence. As new evidence has appeared, there has been growing reliance on results of cost–benefit analysis in early childhood research (e.g., Carroll, Ochshorn, Kagan, & Fuller, 2004; Grunewald & Rolnick, 2004; Heckman & Masterov, 2004).

In this paper, we discuss the evidence on the effectiveness of preschool programs using results from three well-known intervention studies. Our primary focus is the cost–benefit analysis of the preschool component of the Chicago Child–Parent Centers (CPC). The federally funded CPCs are located in high-poverty neighborhoods in Chicago and offer an educational intervention to children from preschool through grades 2 or 3. Reynolds, Temple, Robertson, and Mann (2002) conducted a cost–benefit analysis of the program and found that each dollar invested in the program yields a payoff of seven dollars of benefits to society. We also briefly review the findings from the High/Scope Perry Preschool Program (Schweinhart et al., 2005) and the Abecedarian Project (Masse & Barnett, 2002). Because in contrast to these interventions the Chicago CPC Program is a large-scale on-going program, we highlight its findings.

Using data from the Chicago Longitudinal Study (CLS), which follows a large cohort of students who attended public school kindergartens in high-poverty neighborhoods in Chicago in 1985–1986, our research findings suggest that the early intervention offered by the CPC preschool program is associated with a number of positive outcomes measured in later childhood, adolescence and early adulthood (see Reynolds, Temple, Robertson, & Mann, 2001, 2002; Reynolds & Temple, 2004). Children who participated as of age 3 or 4 are less likely to require school remediation services such as special education placement and grade retention; and they are more likely to complete high school and are less likely to commit crimes as juveniles and young adults.

In any study of the effects of educational interventions, the ability to make causal inferences about the relationship between program participation and later positive outcomes requires a study design to address biases due to omitted variables that are correlated with both program participation and the outcomes of interest. Both the Perry program and the Abecedarian project relied on random assignment of children to treatment and comparison groups. In contrast, the CLS employed a quasi-experimental or matched study design where from the beginning of the study students who participated in the CPC preschool were compared to a matched group of students who enrolled in an alternative intervention offered at other sites. We provide new evidence on the equivalence of the intervention group and the comparison group for the Chicago program on a number of characteristics related to social-economic disadvantage. Using recently obtained administrative data from birth records of the students and the public aid and earnings records of their parents, we demonstrate the strong similarities across many characteristics that may affect the students' school performance, high school completion decisions, and criminal activity. Absent a randomized experiment, our ability to make causal inferences about the effectiveness of preschool programs for children from low-income families is strengthened by a study design in which groups to be compared differ only with respect to participation in the program.

After discussing evidence on the benefits relative to costs of preschool programs for disadvantaged children, we investigate the net benefits for other well-known programs commonly offered as alternatives. These include: health promotion for children from birth to age three; reductions in class sizes in the early grades; policies to retain low-achieving students in grade; and youth job training. Given scarce resources and competing programs intended to benefit disadvantaged children, it is important to consider the impacts of preschool programs compared to other investments that are currently being made.

2. Importance of benefits from preschool programs

Armed with an awareness of potentially sizeable benefits of early childhood programs, policymakers in a number of states have made publicly funded preschool an important part of recent education reforms. The main attractions of preschool programs appear to be their potential for prevention of future labor force and crime problems for participants and the associated reduction in social costs. As described by Heckman and Masterov (2004), the main mechanism through which early education affects labor force productivity and crime is through its effect on cognitive and non-cognitive skills. Prevention of learning problems in the early school years may be more cost effective than waiting until late adolescence or early adulthood to offer costly and less effective treatment or training for those

experiencing difficulties graduating from high school, finding a well-paying job, and staying away from crime (Heckman, 2000).

Policies that increase educational attainment can be an alternative to job training programs offered to increase the readiness of youth and young adults for the labor force. These training programs have been extensively evaluated and the results suggest that they have high costs and relatively low benefits associated with them (Heckman & Masterov, 2004). The recent studies summarized in this paper on the long-term effects of early childhood programs suggest that enriched preschool experiences can increase high-school completion rates. Recent research by economists has attempted to quantify the effects of educational attainment on economic growth. These findings suggest that policies to increase high-school graduation rates can affect economic growth through their effects on labor force productivity (DeLong, Golden, & Katz, 2003). Hence, we can expect that labor force productivity and economic growth can be enhanced by investments in early childhood educational programs.

With respect to juvenile crime, most of the expenditures are allocated for the treatment of families and children after problems have occurred rather than for prevention through early intervention (Aos, Lieb, Mayfield, Miller, & Pennucci, 2004; Cohen, 1998). Social scientists have long noticed a strong relationship between educational attainment and crime (for an attempt to generate causal estimates of the effects of education on crime see Lochner & Moretti, 2004). As in the case of labor force readiness discussed above, the findings that preschool programs can increase high-school graduation rates suggests that preschool interventions, especially high-quality programs offered to children from disadvantaged backgrounds, can be expected to reduce crime.

3. Cost–benefit analysis of preschool programs

The availability of information on the long-run benefits of early childhood programs and the ability of economists to place a monetary value on these benefits and then compare the benefits to the costs have had a great impact on the conversations among policymakers and researchers. Being able to compare monetary values of program benefits and costs allows researchers to determine which programs offer a positive rate of return to society, and the calculation of benefits per dollar of costs helps policymakers allocate resources among competing uses.

In the evaluation of educational and social programs, researchers tend to devote most of their time to the calculation of the program benefits. Costs typically are considered easier to determine (on method, see Levin & McEwan, 2001). For preschool programs, the largest category is the cost of instructional staff. In the CPC, for example, instructional costs amounted to 43% of the total program costs. In order, the next largest categories of costs included costs for administration, operations and maintenance, family support staff, capital depreciation and interest, and the value of parents' time spent in the parental involvement component of the program (Reynolds et al., 2002, p. 275).[1]

Successful preschool education programs can be expected to affect a number of outcomes that can be readily valued in dollars. Many studies have demonstrated the short- and long-term positive effects of participation in preschool programs for a variety of school and social competencies such as academic achievement, need for remedial education and social services, delinquency behavior, educational attainment, and economic well-being into adulthood: Barnett's (1995) review of 36 model and public programs provides a good indication of the magnitude of effects. Across the studies, preschool participation was associated with a 31% reduction in grade retention, a 50% reduction in special education placement, and a 32% reduction in high-school dropout, although this last finding is based on far fewer studies given the rarity of longitudinal samples followed from preschool into adulthood.

The conventional set of possible benefits of preschool education programs are: reduced need for future remedial education services; increased educational attainment or increased test scores; reduced future crime costs (administration and treatment); savings to victims of crime (tangible or intangible); reduced costs in child welfare services (administration and treatment); and improved health. The approaches for quantifying most of these in dollar terms are straightforward. Once calculated, the economic benefits will be divided into three categories. Benefits to participants (e.g.,

[1]These two latter categories require imputation based on assumptions about replacement costs of preschool buildings, foregone interest on money spent on the buildings, and the opportunity cost of parent's time. For more detail on how costs are determined, see Reynolds et al. (2002), Masse and Barnett (2002), and Barnett (1995).

earnings) are experienced by the child and parent attending the program but do not directly benefit others. Benefits to the general public include reduced expenditures for remedial education and social welfare services by governments, reduced tangible expenditures to crime victims, and increased tax revenues due to the participants' higher earnings. Benefits to society at large include the sum of benefits to participants and the general public. We emphasize these societal benefits.

While many of the benefits are realized further out in the future, some benefits can occur in the first few years of elementary school. These benefits are due to the reduced need for remedial school services such as grade retention and special education placement. These benefits can be assigned a monetary value using information from school budgets on the cost of completing an additional year of school and on the costs of various special education programs and of the additional services that some school districts offer to retained students.

The second major benefit of preschool programs is their effect on educational attainment.[2] Once it has been established that successful preschool programs may affect adult earnings through the effect of the program on educational attainment, it is then possible to calculate the additional tax revenues received by the government. This is especially important in cost–benefit analyses that attempt to categorize the various benefits of a program according to who actually benefits—the preschool participant or others in society.

In addition to linking preschool program participation to adult earnings, researchers using longitudinal data are able to relate preschool participation to juvenile and adult crime. A benefit of the program might be that the number and rate of arrests are reduced, which would reduce costs for administration and processing of cases, treatment and incarceration, and costs to crime victims (both tangible and intangible). Similarly, researchers may be able to show that preschool programs that encourage parental involvement may lead to a reduction in child maltreatment, which would reduce expenditures for investigations, administration, and the provision of child welfare services such as in-home or out-of-home care. For both crime and child maltreatment, the benefits of preschool can be disaggregated into benefits affecting the preschool participants themselves (e.g., higher earnings due to reduced chance of imprisonment, and reductions in the pain and suffering for victims of maltreatment) and those benefits accruing to others in society.

However, there is also a set of benefits of preschool education that typically are not included in cost–benefit analyses: improved social and emotional outcomes; social cohesion (or citizenship); improved health of participant's future spouse and children; increased educational attainment of participant's children; increased saving; and increased charitable giving (on measurement and discussion, see Haveman & Wolfe, 1984). There are two reasons why some benefits of preschool education might not be included. The first is that the benefits may be intangible such as higher self-esteem or improved citizenship. The second reason is that cost–benefit analysts are typically encouraged to focus on the major benefits of the program and are discouraged from going too far a field in the search for additional benefits. While an ambitious economist could assign dollar values to the effect of preschool programs on the health of one's future spouse or the future children of the preschool participants using estimates linking preschool participation to educational attainment and estimates from the economics literature linking educational attainment to the health of one's future spouse or the future children, it is possible that the measurement errors associated with such distal calculations might be sizable.

4. Overview of three high-quality preschool programs

We next describe the impact and economic findings of three well-known early education programs, the Chicago CPC Program, the High/Scope Perry Preschool Program, the Carolina Abecedarian Project. Primary emphasis is given to the Child–Parent Center Program as evaluated in the CLS (CLS, 1999). Table 1 provides further details of the programs and studies. To summarize the key features, all three programs provided high-quality educational enrichment to at-risk children in group settings characterized by small class sizes, a focus on language and cognitive skills, and well-qualified and well-paid teachers.

The Carolina Abecedarian Project (ABC) was the most intensive and lengthy, providing full-day, year

[2]There is a long history of calculating the economic benefit of high-school graduation or the avoidance of high-school dropout. The benefit of completing high-school is based on the earnings differences between dropouts and high-school completers, although the question of how much of the earnings differences actually are the result of the differences in educational attainment warrants some attention.

Table 1
Background information about three preschool programs

Characteristic	Perry preschool	Abecedarian	Child–Parent Centers
Years of operation	1962–1967	1972–1977	1983–1985
City and context	Ypsilanti, MI Urban	Chapel Hill, NC Rural	Chicago, IL Inner city
Location	Elementary school	University center	Elem. school or adjacent to
Number of sites	1	1	24
Child attributes	Low SES IQs of 70–85	Low SES High risk	Low SES Reside in Title I area
Race/ethnicity	100% Black	96% Black	94% Black 6% Hispanic
Entry age	3 years	1–4 months	3 years
Mean duration	1.8 years	5 years	1.6 years
Length of day	Part-day	Full-day	Part-day
Other components	Weekly home visits	Medical services Nutrition	Parent program Outreach Health services
Mean class size	22	12 (Infancy) 12 (Preschool)	17
Mean child to staff ratio	5.7 to 1	3 to 1 (Infancy) 6 to 1 (Preschool)	8.5 to 1
Curriculum emphasis	Cognition Child-initiated	Language Traditional	Language Teacher-directed
Staff compensation	Public school	Competitive	Public school
School-age services	None	K to grade 2	K, grades 1 to 3

See: Campbell, Ramey, Pungello, Sparling, and Miller-Johnson (2002); Campbell and Ramey (1995); Schweinhart, Barnes, and Weikart (1993, 2005); Reynolds (2000); Reynolds et al. (2001, 2002).

round care for 5 years beginning at about 6 weeks of age. The children were almost all African American and were at high risk of school failure. Although there was no family component, medical and nutritional services were provided. The experimental impact study included 111 families and study participants have been tracked up to age 21. The High/Scope Perry Preschool Program (PPP) provided the most established and organized curriculum, which employed a child-initiated learning approach. Serving 3- and 4-year-old African American children from low SES families, the program ran for one half of the day (2.5 h) 5 days a week, with weekly home visits by teachers of 90 min. The experimental impact study of the PPP included 123 children. Fifty-eight children were randomly assigned to PPP in five consecutive cohorts. With the exception of the first cohort, children attended for 2 years. The control group included 65 children who were in home care in preschool. Study children have been followed up at age 27 and again at age 40.[3]

The CPC Program provided the most comprehensive services by implementing an intensive parent involvement component, outreach services, and attention to health and nutrition. It also is the only program that became established in public schools and is still in operation. Services begin in preschool and could continue to age 9. The alternative-intervention, quasi-experimental impact study follows 1539 low-income, mostly African American children who attended the CPC program beginning in 1983–1984 or a kindergarten intervention without CPC preschool. The study sample of 989 preschool program and 550 comparison group participants has been followed up to age 22 and data continue to be collected. We discuss in detail

[3]Overall, the findings at age 40 were similar to those reported at the age 27 follow-up. Preschool participants had significantly higher levels of well being than the comparison group in high school completion (77% versus 60%), employment (76% versus 62%), and annual earnings ($20,800 versus $15,300; constant 2000 dollars). Preschool participants also had significantly lower rates of crime as 36% were arrested five or more times compared to 55% for the control group. Whereas 28% of the preschool group was sentenced to jail or prison by age 40, 52% of the control group had this experience. The CBA at age 40 indicated a net benefit per participant in 2002 dollars of $243,712, with a benefit–cost ratio of $17.07.

Table 2
Adjusted means or percentages for program and comparison groups on key outcomes for cost–benefit analysis

Outcome	Perry preschool	Abecedarian	Child–Parent Centers
Original sample sizes (*P*, *C*)	58, 65	57, 54	989, 550
Sample recovery for high-school completion (%)	94	95	87
Special education services by age 15/18 (%)	15 versus 34	25 versus 48	14 versus 25
Grade retention by age 15 (%)	ns	31 versus 55	23 versus 38
Child maltreatment by age 17	n/a	n/a	7 versus 14
Arrested by age 19	31 versus 51	ns	17 versus 25
Highest grade completed by age 21/27 (mean)	11.9 versus 11.0	12.2 versus 11.6	11.3 versus 10.9
High-school completion by age 21/27 (%)	71 versus 54	70 versus 67 (graduation)	66 versus 54
Attend college by age 21/27 (%)	33 versus 28	36 versus 14 (4-year)	24 versus 18
Employed at age 21/27 (%)	71 versus 59	70 versus 58 (teen mothers)	n/a
Monthly earnings at age 27 ($)	1219 versus 766	n/a	n/a

Note. For Perry, special education is for EMI placement by age 15. Ages for educational attainment and employment are 27 for Perry, 21 for Abecedarian, and 22 for Chicago. ns = not significant; n/a = not available.

findings of the CPC program after reviewing the evidence on the cost effectiveness of the three programs.

4.1. Main effects of program participation

The major long-term effects of the three preschool programs are described in Table 2. We emphasize those that are the basis of the CBAs. The estimated impacts of the programs were measured at 17–25 years after the end of preschool participation. Group differences are reported between groups that attended the preschool intervention and those that did not, and are adjusted for child and family background differences between groups such as pre-program IQ, family SES, and other factors. (However, the covariates were different across the three studies.)

Although the magnitude of estimated effects varied across the three studies, participation in all three preschool programs was associated with significantly lower rates of special education services. This impact was large, with preschool participants having rates of special education 40–60% lower than the comparison group. Similar reductions in grade retention were observed for ABC and CPC. Participation in each program also was linked to significantly higher rates of high school completion up to age 27, as well as more years of education. Preschool participation was associated with about a one-half (CPC and ABC) to full year increase (PPP) in educational attainment. Program participants also had higher rates of postsecondary and college attendance. On employment and earnings, only the PPP has shown significant group differences but this may reflect the later age at follow-up. For ABC, differences in employment were largest for teen mothers of program participants. Complete data on employment and earnings are not yet available for CPC, although data collection is continuing.

Finally, both the PPP and the CPC program have demonstrated significant program effects on crime. These effects are large. Participation in PPP was associated with a 40% decrease in arrests by age 19 (from 51% to 31% ever arrested), whereas CPC was associated with at 33% reduction in juvenile petitions by age 18 (from 25% to 17% with one or more petitions). Only PPP has collected data on adult crime, and findings are consistent with those of earlier ages. Overall, these findings show that participation in the preschool programs enhanced participants' well-being over the first two decades of life.

4.2. Estimates from cost–benefit analysis

Table 3 shows the benefits and costs of preschool participation for the three programs.[4] These benefits

[4]The procedure for estimating costs and benefits of preschool participation involves the following steps: (a) calculate program costs and benefits in dollar terms, (b) convert dollar values to 2002 dollars to adjust for inflation, (c) compute the present values of future costs and benefits evaluated at the starting age of

Table 3
Summary of costs and benefits per participant in 2002 dollars for three preschool programs

Costs and benefits	High/scope Perry preschool	Child–Parent Centers	Abecedarian project
Program costs ($)			
Average program participant	15,844	7384	35,864
For one year of participation	9759	4856	13,900
Program benefits ($)			
Total benefits	138,486	74,981	135,546
Net benefits (benefits–costs)	122,642	67,595	99,682
Total benefit per dollar invested	8.74	10.15	3.78
Public benefit per dollar invested (Benefit–cost ratio)	7.16	6.87	2.69

Note. Costs are program expenditures and do not include estimated costs for comparison-group experiences. For comparability to Abecedarian (Masse & Barnett, 2002), values reported in Perry (Barnett, 1996; Schweinhart et al., 1993) and CPC (Reynolds et al., 2002) were converted to 2002 dollars using the Consumer Price Index. Ages of study participants for economic analyses were 27, 21, and 22, respectively. High/Scope and CPC programs were half-day; Abecedarian program was full-day. Doubling the costs of High/Scope and CPC would provide a good approximation for full-day equivalents while one half of the costs of Abecedarian would provide a half-day equivalent. The Abecedarian cost is the marginal program cost, which is the actual program cost minus the cost of in and out-of-home child care for the comparison group. The actual cost per participant was $67,225. Based on the actual costs, total and public benefits of Abecedarian Project per dollar invested are $2.02 and $1.44, respectively. Perry and Chicago program costs are actual costs.

included increased incomes to the program participants, and government savings in terms of reduced expenditures on education, justice system, and health care (as reported in original sources). All values are the estimated benefit per program participant in 2002 dollars. To maintain parallel coverage across programs, we do not include the results of the recent cost–benefit analysis of the Perry project at age 40 (Schweinhart et al., 2005). To be consistent with the Perry study, we also added intangible crime victim benefits for the CPC program.

Although the costs of the programs differ significantly, the economic returns of each program far exceeded the initial investment. The present value of the total economic benefits per participant, both measured and projected over the life course, ranged from $74,981 to $138,486. The present value of the net benefit (benefit minus costs) per participant for the CPCs, an established Title I program offered by a large urban school district, was $67,595. The net benefits for the model programs were larger. The net benefit per participant for the PPP was $122,642. For the Abecedarian project, the net benefits per participant were $99,682.

The benefit for ABC is especially salient given its relatively high cost. Despite the cost of full-day year-round care for 5 years, the program returned per participant nearly $100,000. Indeed, using the actual cost of ABC ($67,225) rather than the marginal program cost (actual cost minus the costs of care for the comparison group) benefits substantially exceeded costs.

Preschool benefits are also described as a ratio of program costs. These ratios can be interpreted as the average return per dollar invested. Benefit to cost ratios provide information on the return on the investment in preschool, whereby $2 dollars of benefits per dollar invested would be a 100% return. All three programs showed a large return on investment based on data collected into adulthood, ranging from a total societal benefit of $4 per dollar invested to $10.15 per dollar invested. The CPC program showed the highest benefit–cost ratio, due mainly to its lower costs. The lower costs are primarily a result of a higher child to staff ratio in the classroom (8.5 to 1 versus less than 6 to 1 for Perry and Abecedarian). The other school-based program, Perry Preschool, demonstrated an economic return of $8.74 per dollar invested. At $3.78 per dollar invested, ABC had the lowest benefit–cost ratio. This is not surprising given its high cost. In terms of public benefits alone (i.e., government and crime victim savings), benefit–cost ratios ranged from $2.69 to $7.16 per dollar invested.

(*footnote continued*)
program enrollment using a discount rate, and (d) subtract the present value of program costs from the present value of total program benefits to obtain the net present value. Because it is common to estimate future benefits for lifetime earnings, reductions in crime, and some other health-related behaviors from observed predictors of these outcomes, future benefits in these domains were projected throughout adulthood. The annual real discount rate used is 3% (see Lipscomb, Weinstein, & Torrance, 1996).

Table 4
Itemized benefits per participant in 2002 dollars for three preschool programs

Costs and benefits	High/Scope Perry preschool	Child–Parent Centers	Abecedarian project
Child care	946	1829	
K-12 education savings	8812	5377	8836
Child welfare savings	–	850	–
Adult education savings	363	–	–
College	−1113	−615	−8128
Participant earnings	38,892	30,638	43,253
Smoking/health	–	–	17,781
Crime savings	90,246	36,902	–
Welfare savings	340	–	196
Maternal earnings, 26–60	–	–	73,608

Note. See the CBA reports of each program for the estimation procedures. The negative benefits of college attendance reflect the fact that taxpayers fund 2/3 of the cost of college. This cost only slightly offsets the earnings increases to participants as well as the increased tax revenues. Earnings are estimates of total compensation before taxes.

As shown in Table 4, there were two main sources of economic benefits. One was increased earnings capacity over the life course, primarily by the program participants: average per participant earnings capacity increased from about $31,000 to $43,000. Earnings estimates were directly measured in PPP and projected by group differences in educational attainment in CPC and ABC. Somewhat surprisingly, increased maternal earnings in ABC was the largest source of economic returns (over $73,000 per person). The second major benefit category was crime savings associated with government savings for justice system treatment or for averted crime victim costs. This category was the largest economic benefit by far for PPP ($90,246 per participant), and the largest category of economic benefits for CPC ($36,902 per participant). For both programs, victim costs included both averted tangible (e.g,, hospitalization) and intangible (e.g., pain and suffering) expenditures.[5] Given that males in both of these studies committed most of the crimes, the benefits for program males in both studies were greater than for program females. ABC reported no group differences in juvenile or adult crime. Finally, all three programs were associated with K-12 education benefits ranging from $5,000 to $9,000 per participant, primarily through savings in special education placement.

[5]The main findings in Reynolds et al. (2002) did not include intangible crime victim savings (e.g., pain and suffering, risk of death) but it was estimated as 3 times the amount of tangible savings. Intangible crime savings per participant was $22,270, comparing to $55,585 in the Perry program.

The high returns shown by each program, despite their major differences in curriculum, geography, and time frame, suggest a high level of confidence for the cost-effectiveness of preschool programs. Given the potential for strong generalizability of the CPC findings to many other established government-funded preschool programs, we describe the study in more detail below. We also report for the first time the findings of many alternative analyses and estimates of the CBA study and place a range on the benefit–cost ratio depending on which assumptions are used.

5. The Chicago longitudinal study of the Child–Parent Center program

The CPC program provides comprehensive educational and family-support services to economically disadvantaged children and their parents beginning at age 3 and continuing until third grade for up to 6 years of intervention. The program began in the Chicago public schools in 1967 through federal funding from the Elementary and Secondary Education Act of 1965. Title I of the Act provides grants to local public school districts serving high concentrations of children from low-income families. After Head Start, the CPCs are the nation's second oldest federally funded preschool program. The 24 centers provide comprehensive services under the direction of the Head Teacher and in collaboration with the elementary school principal. Other primary staff in each center are the parent resource teacher, the school-community representative, bachelor's level classroom teachers, aides,

nurses, speech therapists, and school psychologists (see Reynolds, 2000).

The CLS (CLS, 1999) of the CPC is the most extensive investigation of the long-term effects of a publicly funded preschool program. Prospective longitudinal studies of large-scale, established school-based programs are rare and the CLS is the first to follow program graduates into adulthood. The on-going project investigates program effects for the entire cohort of 989 children born in 1979 or 1980 who attended the preschool program beginning at age 3 and completed kindergarten in the spring of 1986 in the 20 CPC program sites that offered kindergarten. The comparison group of 550 children in this quasi-experimental design did not attend the CPCs but instead participated in an all-day kindergarten program for children at risk in five randomly selected schools. All children in the CLS were eligible for and participated in Title 1-funded educational intervention (either the CPC or the all-day kindergarten) due to high poverty rates in their school attendance area. Because the CPC group contained students from the highest poverty neighborhoods and the comparison group attended randomly selected schools outside of CPC neighborhoods and participated in alternative interventions (primarily a full-day kindergarten program, which was the standard intervention offered to students from low-income families in the mid-1980s), estimates of impact of the CPC program are likely to be conservative. The preschool treatment effects estimated in the CLS are the effects of the enriched preschool program offered by the CPC compared to the ''treatment as usual'' of all-day kindergarten.

Study participants have been followed up to age 22, with a sample recovery rate of 87% for high school completion. No group differences in rates of attrition have been found. Follow-up assessments were conducted each year between kindergarten and seventh grade, and at ages 15, 17–18, and 22 (see Ou, 2003). Over the two decades, extensive information on child and family well-being has been collected through school records, standardized test scores, surveys and interviews of children, parents and teachers, social service records, justice system records, and on postsecondary education. These data provide a unique opportunity to investigate the relationship between program participation and later well-being. Key findings are reported in the Appendix.

5.1. Documenting the characteristics of CPC program groups

Table 5 shows characteristics of the students in the CPC program and comparison groups at the age 20 follow-up using a sample of 1281, which is the number of students out of the original 1539 who had data available on grade retention and special education placement. The estimates of the longer-term effects were obtained using regression analyses that controlled for possible differences between group members using a 6-item risk index. The data for these items listed under the index in Table 5 were obtained from school administrative records and parent surveys. The 6-item risk index is the sum of each item (0 or 1) for each student, and the mean is 3.6 for both the CPC preschool program group and the comparison group. One of the risk factors is the existence of missing survey data from parents, despite the repeated encouragement and reminders from school personnel to complete the survey.

These data indicate that the groups are well matched in terms of economic disadvantage. However, there are a few differences. More of the comparison group had a parent (typically the mother) who had not completed high school or received a GED by the student's enrollment in kindergarten. We have no explanation for why this educational attainment difference arises. On the other hand, students in the CPC program group are more likely to come from higher-poverty neighborhoods. The comparison group kindergarten classrooms were in school attendance areas chosen specifically to match as closely as possible the treatment group on intervention eligibility and high levels of neighborhood poverty. However, because the CPCs are located in the highest poverty neighborhoods, the poverty levels of the most similar neighborhoods are not quite as high. Other than the result for maternal education, the other items in the 6-item risk index suggest that the groups are well matched or that the CPC preschool group may even be more disadvantaged.

More recently, CLS researchers have obtained administrative data from records of birth, public aid receipt, and labor force participation for the students or their parents. From the birth records, information was available on parent's age at child's birth, family size, parent education, and single parent status. Public aid receipt and employment data were also available from other administrative sources in Illinois and surrounding states. Some of

Table 5
Equivalence of CPC groups at the age 20 follow-up ($N = 1281$) and construction of risk index

Characteristic	CPC preschool ($N = 837$)	No-preschool comparison ($N = 444$)	p-value	Original sample p-value
Percent sample recovery	84.6	80.7	–	–
Percent African American	94.1	92.8	0.34	0.95
Percent Girls	52.9	46.8	0.04	0.11
Mean of risk index (0–6)	3.6	3.6	0.55	0.09
Percent from neighborhood with >60% low income	77.9	72.3	0.03	0.04
Child eligible for subsidized meals	92.7	92.9	0.93	0.79
Single parent status	70.4	66.1	0.17	0.27
Parent(s) completed high school	66.1	59.8	0.05	0.02
Parent(s) not employed full or part time	52.5	48.9	0.30	0.61
Missing data on parent education or subsidized meals	24.9	29.6	0.28	0.04
Mean of risk index (0–8)	4.6	4.5	0.56	0.80
Percent from neighborhood with >60% low income	78.0	72.0	0.03	0.04
Child eligible for subsidized meals (updated)	84.0	83.0	0.69	0.38
Single parent status as of child's birth	78.0	75.0	0.26	0.61
Percent of mothers who did not complete HS by child's birth	52.0	60.0	0.01	0.00
Percent of mothers not employed by child's age 3	66.0	60.0	0.04	0.12
Percent participation in AFDC by age 3	64.0	61.0	0.36	0.61
Percent have 4 or more children by child's birth	16.0	19.0	0.27	0.28
Percent teen parent at child's birth	9.7	10.3	0.76	0.70

the new information differs from that in the 6-item risk index due to missing data in the original measures and also due to the different times at which the data were collected. Besides providing additional information on the characteristics of the students, these new data also provide support for the equivalence of program and comparison groups. The mean number of risk factors listed below the 8-item index in the table is 4.6 for the CPC preschool group and 4.5 for the comparison group.

6. Investigating alternative estimates of program effects and cost effectiveness

In this section, we test the robustness of major elements of the cost–benefit analysis of the CPC program, including (a) choice of discount rates, (b) treatment of benefits of reduced crime to crime victims, and (c) alternative approaches to estimating the effects of the program on key outcomes. We also review evidence about the mechanisms of CPC effects.

The choice of discount rate can have a large impact on estimated benefits, especially when benefits are expected to occur far in the future. Researchers tend to use annual discount rates ranging from 0% to 7%. In most early childhood studies, a 3% discount rate has been used. As shown in Fig. 1, the total benefits of the CPC preschool program, as estimated in the 2002 study, substantially exceeded costs across all discount rates shown. With a 5% rate, the ratio of benefits to costs was reduced to about 5 to 1. A 7% rate reduced this ratio to about 4 to 1. Estimates of returns to the general public (tax payers and crime victims) also were robust across a range of discount rates.

Much of the economic benefits of early childhood programs are cost savings from reductions in crime. Three costs are readily estimated: administrative costs for processing individuals in the criminal justice system, treatment costs, and tangible costs to crime victims such as lost productivity, hospitalization, or property damage. However, intangible costs to crime victims—the pain and suffering and risk of death caused by crime—are more difficult to estimate. Given the lack of consensus about their use, we did not include intangible benefits in the main results of our 2002 study. The decision to include or not include them has a large impact on economic returns. For example, in the age 27 study of the Perry program, intangible crime victim savings per participant were estimated at $55,585, i.e., 40% of the total returns. With these intangibles excluded, the economic return per dollar invested is reduced from $8.74 to $5.23. Using the same method of calculation as in Perry, which is based primarily on jury awards (see Barnett, 1996), the inclusion of intangible crime victim benefits in the

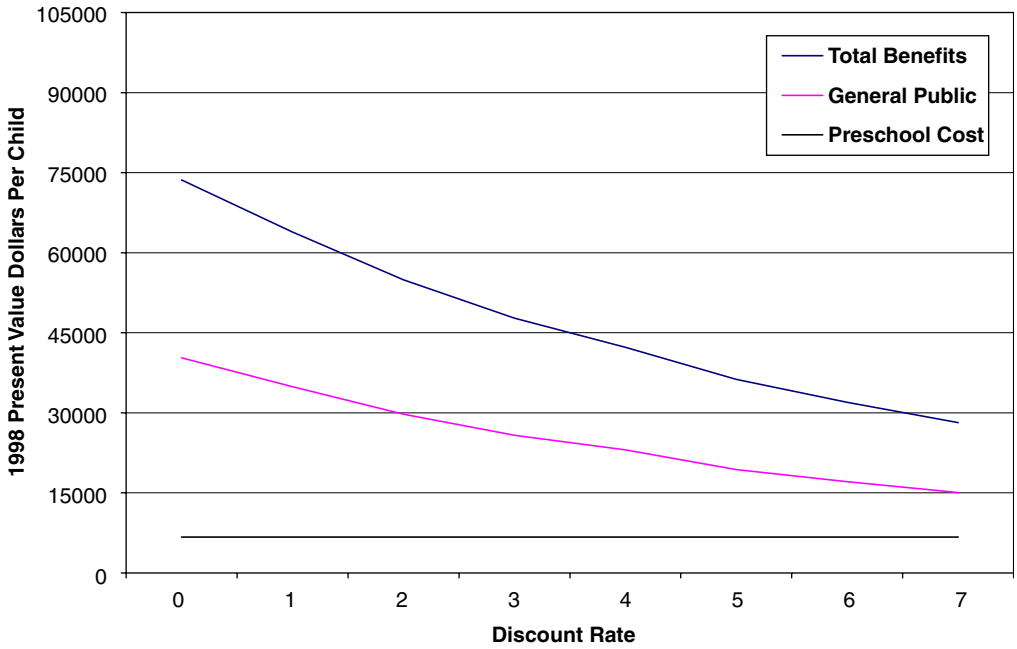

Fig. 1. Economic returns of CPC preschool participation as a function of discount rate.

CPC study increases the total economic return per participant by $22,270, from $52,711 to $74,981. The economic return per dollar invested for preschool increases from $7.14 to $10.15. Similar increases for the school-age and extended programs also were found.

Some estimates of the effects of preschool participation from the CLS on longer-term outcomes were reported in Reynolds et al. (2001) and were used in the cost–benefit analysis in Reynolds et al. (2002). Here, we examine the robustness of these results for the need for school remediation services, high-school completion (graduation or GED attainment) and juvenile arrests by making several changes to the previous analyses. First, we re-estimate the effects of CPC preschool participation by using an alternative economic specification and by incorporating the new risk index, which includes a richer set of family background characteristics. Then, we adopt more plausible assumptions about the lifetime earnings differences that are likely to result from high-school completion.

The results reported in Reynolds et al. (2001) were obtained by including a series of site dummy variables, where the site refers to the center or school attended in the student's kindergarten year. This estimation strategy is useful because fixed effects estimation can control for unobserved site-level characteristics that might be correlated with program participation and the outcomes of interest. However, in the CLS data set, a comparison of the across- and within-site variation in outcomes demonstrated great variation within sites. Due to the intentional similarity of the students enrolled in the treatment and comparison group sites, there exist much greater within—site variation in the high-school completion, need for school remediation services, and juvenile arrests data. For example, in the case of the number of juvenile arrests as of age 17, 98% of the variation in this outcome is attributed to within-site variation, while only 2% is due to across-site variation. A drawback of this estimation strategy is that the use of fixed site effects implies that the estimated treatment effects were obtained entirely from the students within each site who entered kindergarten in a CPC program site without previous enrollment in the preschool intervention. There were over 230 students who attended kindergarten in the CPC program sites but had not participated in the CPC preschool. While most of the variation in the observed outcomes is within sites, most of the observed variation in treatment exposure (as intended by the study design) is across sites.

In the estimates reported below, we examine the determinants of the same outcomes reported in

Table 6
Estimated effects of CPC preschool participation using probit and count data models

	Ever retained in grade	High-school completion	Years of special education	Number of arrests
Constant	−0.327 (0.240)	0.292 (0.251)	−0.862 (0.813)	−0.397 (0.320)
Female	−0.168* (0.022)	0.165* (0.024)	−0.872* (0.313)	−1.262* (0.253)
African-American	0.129** (0.073)	−0.129** (0.074)	0.597** (0.354)	0.316 (0.273)
New risk index (0–8)	0.039* (0.010)	−0.065* (0.010)	0.010 (0.040)	0.134* (0.066)
CPC preschool participation	−0.073* (0.030)	0.092* (0.027)	−0.482* (0.191)	−0.238** (0.136)
CPC school age program participation	−0.110* (0.027)	−0.004 (0.039)	−0.439* (0.176)	0.044 (0.123)
Neighborhood variables included?	Yes	Yes	Yes	No
Correct predictions	72%	62%	1048/1052	1177/1129
N	1281	1233	1281	1404

Standard errors in parentheses. * denotes significance at 5% level for two-tailed test; ** denotes significance at 10% level. Coefficients reported are marginal effects. Outcomes in columns (1) and (2) were estimated using probit models while the equations in columns (3) and (4) were estimated using zero-inflated negative binomial models. Correct predictions in columns (1) and (2) are the number of 0s and 1s predicted correctly, while the correct predictions in columns (3) and (4) are the ratio of predicted 0s to actual 0s.

Reynolds et al. (2001) by making several changes to the analyses. We no longer control for site fixed effects, but we add several intervention-level neighborhood characteristics. We investigate the importance of allowing for a within-site variation in the error terms. We also employ the new more comprehensive risk index. Probit models are used to estimate the effect of participation in the preschool component of the intervention on grade retention and high-school completion. Count data models are used to estimate the effect of preschool intervention on the number of years of special education placement and the number of juvenile arrests.

The first two columns of Table 6 report estimates of the effect of preschool on grade retention and high-school completion. The results indicate that participation for 1 or 2 years is associated with a 7.3 percentage reduction in the probability of grade retention and a 9.2% increase in rates of high-school completion as of age 20.[6] The last two columns of Table 6 report results of zero-inflated negative binomial models for the number of years in special education and the number of juvenile arrests.[7] Participation in the CPC preschool is associated with a reduction in the number of years of special education of 0.48 years. Preschool participation reduces the number of arrests by 0.24.

The point estimates for the effects of CPC preschool participation shown in Table 6 tend to be smaller than those reported in the 2001 study by Reynolds et al. The 2001 study reported preschool effects of −15.4 percentage points for grade retention, 11.2 percentage points for high-school completion, −0.70 years of special education, and −0.33 number of arrests. Most of the differences in the estimation appear to come from the use of the fixed effects approach in the earlier study, with the use of a different risk index having only a small effect on the estimates. We recalculated the benefits of the

[6]While not shown here, both regressions included a set of four neighborhood characteristics reflecting neighborhood poverty in the Census community area associated with the kindergarten site. These variables include the percent of households (1) headed by a female, (2) receiving public aid, and (3) with incomes less than 200% of the poverty line. The unemployment rate also is included. (Standard errors were adjusted for within-site correlations in errors.) While none of the neighborhood variables are individually significant, LR tests indicate that they are jointly significant at the 10% level.

[7]Negative binomial models are preferred when the variance of the outcome exceeds the mean, and simple *t*-tests suggested by Cameron and Trivedi (1990) support this specification. Zero-inflated models can be appropriate for count data where there are a large number of zeros. For years of special education, the observations range from zero to 12 with a mean of 0.97, with 1052 zeros. For number of arrests the mean is 0.57, the range 0–15, with 1120 zeros. The model used here predicts the zeros very accurately for special education, but overpredicts zeros in the arrest equation. Because convergence in these negative binomial models proved difficult, neither equation accounts for a within-site correlation in errors. Random effects models generated an estimate of the site-specific correlation in errors, and only in the case of grade retention was this correlation statistically significant. We were unable to estimate the ZIP negative binomial model for arrests while including the neighborhood characteristics.

CPC program as reported in Reynolds et al. (2002, Table 5) by reducing the benefits attributable to each outcome by the ratio of the new point estimate shown in Table 6 relative to the original point estimates. Using the smaller estimates of program benefits shown here, the new benefit cost ratio is $5.98 instead of the $7.14 reported in the earlier study (not including the intangible benefits to crime victims).

In addition to re-estimating the program effects by conducting new regression analyses, we also re-estimate the earnings gains that preschool participants experience due to an increase in the probability of high-school completion. In the 2002 study, we estimated a lifetime earnings gains of high-school completion (including obtaining a GED) by looking at the BLS statistics on the earnings of black men and women with various levels of educational attainment. Our earlier study used data from a BLS chart describing men and women who had worked full-time year round. However, numerous studies indicate that black high-school dropouts are less likely than other groups to be working full-time year around. When we use instead the chart describing the annual earnings of black men and women with "any earnings", the earnings gain attributable to high-school completion rises from our estimated present value of $183,183 used in the 2001 study to a new estimate of $211,062. This alternative measure of the gain of high-school completion, when combined with the new treatment effects shown in Table 6, generates a new benefit–cost ratio for the CPCs of $6.50.

The high economic returns demonstrated in the CPC program lead to a fundamental question for human capital policy: Which child, family, and school-related processes account for the economic benefits? Although difficult to determine precisely, one approach is to investigate the extent to which the main effects of participation are mediated by intervening factors after the end of participation. For the CPC, attempts have been made to determine which child, family, and school-related processes help generate the long-term benefits. In the early intervention literature (e.g., Reynolds, 2000), five mechanisms have been proposed. Similar to the human capital perspective of skill formation (Heckman, 2000), developmental researchers focus on the possibilities that long-term benefits of early intervention may be sustained through the cognitive advantage, motivational and social adjustment advantages, and through family and school support behaviors. Economists studying the longer-term effects of Head Start have investigated the importance of the fifth mechanism by examining whether attendance in better quality schools after Head Start helps the early achievement gains persist (Currie & Thomas, 2000).

In an attempt to investigate and quantify the importance of the five mechanisms, Reynolds, Ou, and Topitzes (2004) found through structural equation modeling that the cognitive advantage, family support, and school support hypotheses were the most important in the maintenance of the gains in the Chicago CPCs. Through early intervention's effects on kindergarten achievement, the cognitive advantage suggests that early gains in achievement can be linked to better performance in school later and to fewer arrests as higher early achievement provides cumulative advantages over time. The higher level of parental involvement in children's education stimulated by the CPC program is an example of the family support hypotheses, and Reynolds et al. (2004) demonstrate that parental involvement also is associated with better school performance and fewer arrests. Finally, the fact that students who participated in the CPC intervention were more likely to attend better quality high schools (primarily magnet schools) and were less likely to change schools demonstrates the relevance of the school support hypothesis. The motivational advantage (school commitment) and social adjustment (classroom adjustment) hypotheses made smaller contributions but contributed to a good model fit.

7. Benefits and costs of other programs for children and youth

There is no shortage of policies and programs for investing in children and youth. As Heckman (2000, p. 50) notes, "in evaluating a human capital investment strategy, it is crucial to consider the entire policy portfolio of interventions together—training programs, school-based policies, school reform, and early interventions—rather than focusing on one type of policy in isolation from the others". In this section we review the evidence from several popular interventions and policies that have accumulated enough evidence to estimate economic benefits relative to costs. These programs and policies include prenatal and early infancy interventions focusing on nutrition and home visitations by nurses, class size reductions, grade retention, and

Table 7
Economic costs and benefits for alternative investments in children and youth in 2002 dollars

Program and source	Per participant cost	Estimated benefits ratio	Benefit–cost
Women, infants, and children (WIC, Avruch & Cackley, 1995)	958	2941	3.07
Prenatal/early infancy project (Karoly et al., 1998)	6975	35,288	5.10
Tennessee STAR class size reduction in K-3 (Krueger, 2003)	8454	23,913	2.83
Child–Parent Center school-age program (Reynolds et al., 2002)	3290	5457	1.66
Grade retention (Temple, Reynolds, & Ou, 2003)	7959	−26,434	−3.32
Job Corps (Long et al., 1981)	15,141	19,958	1.32

Note. Values were converted to 2002 dollars using the Consumer Price Index. Costs for WIC are for 2 years of services. In the other programs, costs are for the average length of participation.

youth job training. A summary of costs and benefits is shown in Table 7.

7.1. Prenatal and early infancy programs

Since 1972, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) has provided nutrition education, referrals to social services, and a variety of food supplements to low-income families to promote healthy prenatal development and nutrition practices through the preschool period. A meta-analysis of 15 cross-state studies by Avruch and Cackley (1995) found that WIC participation was associated with a 25% reduction in the rate of low birth-weight births, which significantly reduced the amount of hospital costs paid by public and private payers during the first year of life. At an estimated cost per participant for two years of $958, the economic return in savings to Medicaid and other payers was $3.07 per dollar invested in the program.

The Prenatal/Early Infancy Project (Olds et al., 1997) is an intensive nurse home visitation program for young mothers having their first child. For the high-risk sample, Karoly et al. (1998) found that participation from prenatal development to age 2 was associated with lower rates of criminal behavior for both mothers and target children, lower rates of substantiated child maltreatment, higher earnings capacity for the mothers, and increased tax revenues projected into adulthood. At a program cost per participant of $6975 in 2002 dollars, the estimated economic return was $5.10 for every dollar invested in the program.

7.2. Class size reductions in the early elementary grades

Reducing class sizes, primarily in the early grades, is a policy that has been implemented or is being considered in many states. While some proposals are for class-size reductions in schools that draw a high proportion of students from low-income families, other proposals are for all students. Consequently, there are interesting parallels between this policy and interest in universal access for preschool. Many of the recent discussions on small class sizes are based on evidence on student performance and class size that comes from the large-scale randomized experiment called Tennessee STAR (e.g., Mosteller, 1995). Given the significant costs of reducing class sizes, economists debate whether significant benefits exist to make this policy a cost-effective option. On the one hand, Card and Krueger (1996) and Krueger (2003) present evidence in support of reduced class sizes, while other economists (including Hanushek, 1999) are less convinced that the benefits will outweigh the costs by a significant amount.

Recognizing that there is controversy over the magnitude of the benefits, we present in Table 7 calculations of the costs and benefits of class size reduction in the early grades offered in the Tennessee STAR experiment from Krueger (2003). A reduction in class sizes during the early years of elementary school is found to have a benefit–cost ratio of 2.83.[8] To calculate the costs of increased

[8]Because these estimates are new and relatively large, we provide some explanation of how these estimates were obtained. In his analysis, Krueger (2003) finds that students with an average

class sizes, Krueger (2003) assumes that a reduction in class sizes from 22 to 15 students requires a 7/15 or 47% increase in school spending. The annual cost of a year of schooling per student was $7502 in 1998, and 47% of that amount is $3501. After assuming that these expenditures occur in the first 2.3 years of schooling, the present value of this increase in schooling costs is found to be $7660 in 1998 dollars. In 2002 dollars, the present value of the per pupil cost of increased class sizes for 2.3 years is $8454. The present value of per pupil costs of a full four years of reduced class sizes would be $14,794.

Additional evidence on small class sizes comes from the school-age CPC program, of which the main program element was a reduction in class sizes from 35 to 1 to 25 to 2 (teacher and aide) during grades 1–3. The school age program also included instructional resources to promote reading and math achievement and family support activities under the direction of a program coordinator. Controlling for preschool participation and child and family attributes, school-age participation was independently associated with significantly higher levels of reading achievement at age 9, and with lower rates of grade retention (24% versus 34%) and special education placement (15% versus 21%) up to age 18. At an average per child cost of $3290 in 2002 dollars for 2 years of school-age intervention, the economic return was estimated at $1.66 per dollar invested (Reynolds et al., 2002). While this return per dollar invested is much lower than that of the CPC preschool program, it is within the range of that found for Tennessee STAR.

7.3. The educational policy of grade retention

Policies that require underachieving elementary students to repeat a grade have become a popular approach in school reform. Relative to social promotion, the goal of grade retention is to improve achievement and ultimately to reduce the chances of school dropout. Unfortunately, most studies show that grade retention is associated with lower achievement in later grades, and an increased probability of school dropout (Heubert & Hauser, 1999). To determine the economic costs and benefits of grade retention, we multiplied the difference in adjusted rates of high school completion for youth ever retained or not retained in the CLS (−13.5 percentage points; 36.8% versus 50.3%, respectively) by the projected difference in life-time earnings per participant between high-school completers and non-completers using estimates by the Census Bureau (as used in the CBA of the CPC program). Discounted at 3% and assuming 2% annual increases in productivity, high-school completers would be expected to earn $202,176 more than high school dropouts by age 65. With a per participant cost of retention of $7959, one additional year of schooling, the estimated economic return was −$3.32 for every dollar invested. This large negative return is exclusive of lost tax revenues and factors in the optimistic assumption that students who are retained will be less likely to receive special education services.

7.4. Youth job training

The federally funded Job Corps is the most well-known training program for at-risk youth, most of whom have dropped out of school. Providing up to 7 months of vocational training and education in a residential setting, Job Corps graduates typically earn more than their comparison group counterparts, and can have lower rates of crime (cf. Heckman, 2000). At a cost of $15,141 per participant, the estimated economic return was $1.32 per dollar invested (Long, Maller, & Thorton, 1981). Most other job training programs for young people and adult education programs show benefit–cost ratios of less than one (e.g., Heckman, 2000).

In summary, the economic benefits of preschool education far surpass those of the other programs reviewed. Only WIC and the Prenatal/Early Infancy Project early interventions showed economic returns that were sizeable relative to costs. Benefits of the Tennessee STAR class size experiment were slightly lower. Thus, we conclude that programs offered before kindergarten have the highest economic returns.

(*footnote continued*)
of 2.3 years of small class sizes in years K-3 were shown to have a 0.2 standard deviation increase in test scores, and he assumes that this increase in test scores is associated with a 1.6% increase in adult earnings. Data on adult earnings are taken from the March 1999 CPS. Evaluated at kindergarten entry, the present value of this benefit from small class sizes is $23,913. Krueger presents results for various discount rates and various assumptions about annual productivity growth. We choose his estimates for a discount rate of 3%. To best match the assumptions made in the CBA of the Chicago CPCs, we choose his benefit calculations that assume an annual productivity growth rate of 1% and total earnings growth of 2% per year.

8. Generalizability of the evidence and policy implications

The Perry, Chicago, and Abecedarian studies have important similarities in that the interventions served almost exclusively African American children from low-income households. Yet the consistency of the findings of the economic effects of these three programs despite major differences in social context and location, time period, and curriculum approach are encouraging evidence in favor of expanding preschool access.

While there is no comparable long-term evidence from studies of middle income families or from more diverse samples, research on the short-term effects of high-quality child care and state-funded preschool programs, which serve more economically and racially diverse populations, provides additional evidence on generalizability across population groups. Although the effect sizes for high-quality child care and state preschools on school readiness are smaller than for the intensive interventions, they are generally sizable and educationally meaningful. Based on a comprehensive research synthesis of state-funded preschool programs in six states and the District of Columbia, Gilliam and Zigler (2001) found a mean effect size of 0.36 SD for school readiness based on measures of cognitive, language, or literacy development in preschool or kindergarten. The range of effect sizes was 0.23 for kindergarten reading in Florida to 0.45 for kindergarten cognitive-language development in Michigan. An updated analysis to 2003 showed similar findings (Gilliam & Zigler, 2004), with one study of the new Oklahoma universal preschool program in Tulsa showing substantial effects on school readiness Gormley, Gayer, Phillips, and Dawson (2005).[9] Overall, effect sizes for child care and state-run preschools were approximately 30–40% lower than those of PPP, ABC, and CPC. Nevertheless, the findings show that positive impacts of early education programs for more economically diverse samples of children are possible. Of course, there are many other benefits of expanding access to early education that cannot be easily measured in effect sizes and economic returns. For example, establishment of a universal access system would increase the equality of opportunity in enrollment in early education that would be less dependent on ability of pay and state and locality of residence.

Understanding the ways in which various educational intervention programs affect skill formation or affect child development through the various developmental hypotheses described earlier potentially can enhance the generalizability of research findings. For example, in Krueger (2003)'s cost–benefit analysis of reduced class sizes, the benefit of interest is increased earnings in adulthood. He makes no assumptions about the effect of reduced class sizes on juvenile and adult crime. When comparing enriched preschool programs to reduced class size programs, the literature on early childhood programs would suggest that these preschool programs are more likely to affect crime due to preschool's presumably greater effect on noncognitive skills and due to the family support and school support developmental hypotheses mentioned above.

While the generalizability of the findings of these studies to other populations is limited by the low SES of participants, two strengths of this body of research are evident. First, substantial benefits were found for all three programs despite their differences in content and focus, timing and duration, geography, and decade of implementation (1960–1980s and beyond). Second, evidence from recent studies of child care and state-funded preschool programs (which enroll children across income groups) shows a similar pattern of impacts on school readiness, the major precursor of long-term effects. We also compared the benefits of preschool education to those of other social programs for children and youth that currently have high funding priority.[10] While our comparison is hindered somewhat due to the fact that the studies each focused on a different range of outcomes, the findings suggest that investments in preschool had substantially higher net benefits and benefit–cost

[9] In the NICHD Study of Early Child Care, which tracks the development of over 1300 children from primarily middle-income families in nine states, Vandell and Pierce (2003) reported an adjusted effect size of 0.43 SD on the Bracken school readiness composite at age 3 for children in high-quality child care compared to children in low-quality care. Similarly, in the four-state Cost, Quality, and Outcomes study of nearly 600 children, Peisner-Feinberg et al. (1999) found an adjusted effect size of 0.40 SD for receptive language at ages 4 and 5.

[10] This type of comparison has not been made elsewhere in the economics of education literature. As Levin and McEwan (2001, pp. 14–15) indicate "in selecting from among several alternatives, one would choose that particular one that had the highest benefit–cost ratio".

ratios than several education, job training, and health service interventions. Most other social programs, from child welfare treatment to delinquency prevention, have even weaker records of effectiveness (Guterman, 1999; Reynolds & Robertson, 2003). Certainly, many other programs can be offered in addition to investments in enriched preschool. Due to their high rates of return, good-quality preschools, however, deserve a greater share of public investments in children and youth. Currently, less than 1% of total expenditures spent on social programs goes to prevention services (National Science & Technology Council, 1997).

Will the economic benefits of preschool education for children from middle and upper income families be equivalent to those for children from low-income families? To the extent that participation in educational day care, state-run preschool programs, preschool programs for children at risk, and universal access programs directly impact main predictors of delinquency and school completion such as school achievement and the home environment, longer-term effects are more likely and they could translate into significant economic returns.

The CBA findings for the CPC program add significantly to the literature by indicating that larger-scale public programs run by schools can produce the same pattern of benefits as model programs. Because the CPC study is the first cost–benefit analysis of a public preschool program, the findings increase the generalizability of results to publicly-funded programs, including emerging universal access programs. Findings also indicate that school-based prevention programs during early childhood can reduce the need for remedial education, child maltreatment, and delinquency. This is especially relevant given the paucity of evidence that programs to prevent maltreatment and delinquency are cost-effective (Zigler, Taussig, & Black, 1992).

9. Conclusions

According to the NCES (2003, Table 43), nearly two in five children do not enroll in center-based preschool programs before entering kindergarten. Compared to more affluent parents, parents from lower-income families are less likely to send their children to preschool and are less able to afford to send their children to higher-quality programs. The findings reviewed here from three well-designed studies suggest that greater investments in high-quality preschool programs, especially those enrolling children from disadvantaged families, are warranted. Unlike a decade ago, scientific support for the benefits of preschool programs is strong. A major conclusion from these findings for early childhood policy is that for the first time a critical mass of evidence exists that preschool programs have comparatively high levels of cost effectiveness.

Public investments in early education programs are warranted on efficiency grounds for two reasons. First, as documented in the Abecedarian, Perry, and Chicago Child–Parent studies, early educational interventions generate benefits that spillover to others in society. The existence of positive externalities is a common justification for public investment. A second efficiency-related rationale for increased spending on early education involves the existence of borrowing constraints faced by lower-income families. Even if all families were aware of the long-term benefits of early intervention, the families who might benefit the most are the least likely to be able to borrow against their children's possible higher future incomes.

While the discussion here has focused on the effect of investments in enriched preschool education on educational attainment, achievement, earnings, and reduced crime, there are also issues of fairness involved in the establishment of a high-quality preschool programs intended to serve children from low-income families. Recent research by Restuccia and Urrutia (2004) shows that parental investments in early education can explain earnings persistence across generations. Restuccia and Urrutia argue that the existence of borrowing constraints affecting parental investments in early education leads to the persistence of low earnings in these families for generations. While "early education" in their model refers to elementary and secondary education, given the high returns to high-quality preschool programs, it is clear that their conclusions may apply to education in the preschool years as well. Government intervention to subsidize early childhood investments by borrowing-constrained low-income parents not only may increase labor force productivity and reduce crime, but it can also serve to increase income mobility over time for low-income families.

Appendix A

Performance of CPC preschool and comparison-group children for indicators of later well-being are given in Table A1.

Table A1

Child outcome	Age	CPC Program group	Comparison group	Group difference	Pct change over compare group
School readiness and achievement					
At/above national norm on scholastic readiness	5	46.7	25.1	21.6	+86
At/above national norm in reading achievement	14–15	35.0	22.0	13.0	+59
Family support behavior					
Three or more positive ratings of parent involvement	8–12	30.9	21.0	9.9	+47
Child maltreatment (Court reports)	4–17	5.0	10.3	5.3	−52
Child maltreatment (Indicated DCFS reports)	4–17	6.9	14.2	7.3	−52
Remedial education					
Repeated a grade	6–15	23.0	38.4	15.4	−40
Special education	6–18	14.4	24.6	10.2	−41
Juvenile delinquency					
Juvenile arrest	10–18	16.9	25.1	8.2	−33
Arrest for violent offense	10–18	9.0	15.3	6.3	−41
Two or more arrests	10–18	9.5	12.8	3.3	−26
Educational attainment by age 21					
Completed high school	18–21	61.9	51.4	10.5	+20
Highest grade completed (mean number of years)	13–21	11.23	10.87	0.36	+03

Note. All differences were statistically significant. Rates adjusted for group differences in sex of child, race/ethnicity, participation in school-age intervention, and family risk status. Pct change—percentage change over the comparison group. Sample sizes range from 1102 (school readiness) to 1404 (juvenile delinquency).

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