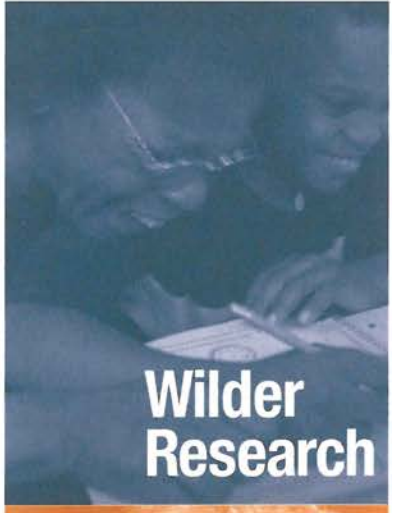

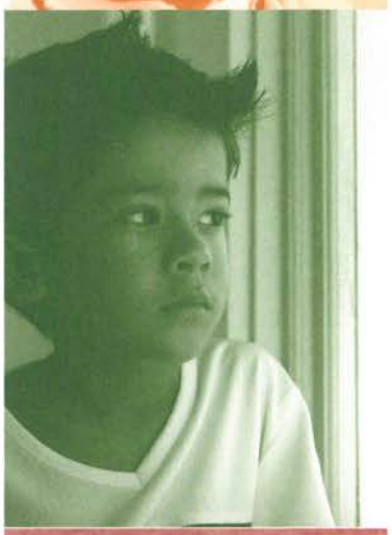

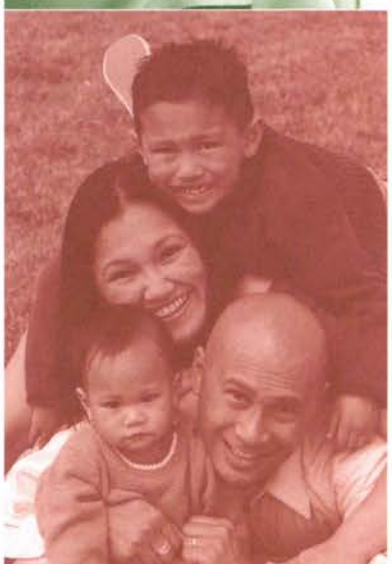

Potential return on investment of the Project Early Kindergarten

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Summary

Background

Research studies have demonstrated that investing in effective early education programs that prepare young children cognitively, physically, socially, and emotionally for success in school – particularly low-income children at risk of school failure – prevents or reduces needless public spending throughout the educational, social services, and criminal justice systems for juveniles and adults. Early school readiness also increases future state revenues by lowering drop-out rates and insuring a skilled workforce that contributes to the tax base.

Potential lifetime cost savings of school readiness per child

Potential benefits and return on investment (ROI) of Project Early Kindergarten (PEK) are estimated based on the following scenarios:

- A full impact scenario where benefits are computed using undiscounted effect sizes from the literature on the impact of early childhood education (ECE) on relevant outcomes. This scenario assumes that PEK has the same levels of impact as other ECE programs such as the Child Parent Center in Chicago, High/Scope Perry Preschool, and Abecedarian.

- Potential returns that PEK would produce under the assumption that the program is only 50 percent as effective as other ECE programs.

- A break-even scenario where it is shown the level of impact of PEK relative to the impact of major studies that is required to pay back the investment made in the program.

These scenarios are constructed to estimate the benefits of PEK based on different levels of potential effectiveness of the program.

We also estimate the additional future income that PEK participants will earn based on their improved math scores. Based on this outcome and the estimated future benefits, we compute an estimated ROI. This is a partial ROI since it only accounts for one source of benefits.

A conservative estimation of the potential lifetime economic benefits of investing in PEK is $56 million in present value, discounted at a 4 percent discount rate. The potential ROI for the society of PEK is estimated at between $3.3 and $10 for every dollar invested. Taxpayers can potentially obtain $1.7 to $4.6 in return for every dollar invested in the program; while private funders can potentially obtain $4 to $23 for every dollar invested in PEK.

1. Potential return on investment in Project Early Kindergarten

Full impact scenario: returns using major early childhood education outcomes			
	Society	**Taxpayers**	**Private Funders (McKnight Foundation)**
Potential total savings (millions)	$56.3	$18.6	$37.7
Cost (millions)	$8.6	$4.1	$4.5
ROI	6.6	4.6	8.4
Discounted impact scenario (50% discounted benefits)			
Potential total savings (millions)	$28.2	$9.3	$18.9
Cost (millions)	$8.6	$4.1	$4.5
ROI	3.3	2.3	4.2
Minimum impact scenario to recover investment (break-even)			
Relative discount	**15%**	**22%**	**12%**
Potential total savings (millions)	$8.5	$4.1	$4.5
Cost (millions)	$8.5	$4.1	$4.5
ROI	1.0	1.0	1.0
Returns based on increased standardized test scores of PEK participants			
Benefits (millions)	$13.8	$1.4	$12.4
Cost (millions)	$2.9	$1.8	$1.1
ROI	4.7	0.79	10.9

Methods

These estimates are based on actual high school graduation and expenditure data, poverty rates, crime rates, and other data for Minnesota obtained from the Minnesota Department of Education, as well as from the Census Bureau and the National Archive of Criminal Justice Data. We use ECE program effect sizes and parameters from the existing research on effects of early childhood education to assess the potential impact of PEK on relevant outcomes and assign monetary values to these outcomes. The reported values are present values (4% discount rate) of lifetime savings or benefits and costs based on assumed span of productive work life of participants, expected lifespan, and other demographic assumptions commonly used in evaluation of early childhood programs.

The outcomes included in this analysis are:

K-12 schools – through reduced special education and grade repetition.

State government – through reduced costs of dealing with juvenile and adult criminals; through lower welfare, Medicaid, and unemployment costs; and through higher tax revenues as successful students become productive adults.

The public – through reduced juvenile and adult crime victimization and costs due to injuries and property losses, reduced alcohol and drug abuse costs, and higher future personal income and tax revenues from better prepared children.

Conclusions

School readiness for more young children is critical for tackling Minnesota's economic and social challenges. Investing in school readiness can produce a more educated and skilled workforce and social returns with substantial economic value. PEK can potentially be a source of these returns; however, the effectiveness of PEK in producing the potential returns shown in this report is contingent on the quality and intensity of the program to be as effective as other recognized early childhood programs. Evidence of this potential is the high return that the 3rd cohort of the program can generate due to their increased academic achievement.

Introduction

Purposes of this study

This study demonstrates the potential economic value to state government, private funders, and the society of investing in Project Early Kindergarten (PEK) in Saint Paul, Minnesota. The economic value of investing in early childhood education takes the form of savings. For example, children who attend preschool require less special education, repeat grades less, have fewer behavioral problems in school, graduate at a higher rate than others, and have less involvement in the very expensive criminal justice system as both juveniles and adults. As adults they earn higher incomes, contribute more in taxes, and are more likely to be employable and employed in the new economy. In these and other respects, high quality preschool experience can lead to savings in the K-12 educational system, criminal justice system, and social welfare system.

This study builds on models and methods used in recent studies in Minnesota, Michigan, and Illinois. It translates the best research on the returns associated with comprehensive early childhood education (ECE) into usable estimates of the potential returns for investing in PEK. It also shows estimated future benefits of PEK based on actual academic improvement outcomes from the program.

Overview of early childhood education cost/benefit literature

Many studies show that high-quality early learning experiences pay off in the long run (Ehrlich and Kornblatt, 2004; Karoly, Kilburn, & Cannon, 2005; Friedman, 2004; Lynch, 2007; Temple and Reynolds, 2005; Reynolds, 2007; Rolnick and Grunewald, 2003). Most of the return on investment is realized through reduced public costs associated with child welfare, public assistance, crime and incarceration, and benefits related to increased education and earnings.

Several studies focus specifically on measuring the effects of early childhood interventions and quality early care and education on school systems and time spent in K-12 special education and special education spending (Barnett, 1995; Belfield, 2004; Conyers, Reynolds, and Ou, 2003; Harvey, 2006; Reynolds, 2007).

Other studies focus on the impact of early childhood education programs on additional areas of government spending, including criminal justice, public assistance, Medicaid, unemployment, child welfare, health care, and child care (Aos, et al., 2004; Mann and Reynolds, 2006; Nores, et al., 2005; Oppenheim and MacGregor, 2002; Reynolds, et al. 2002).

Finally, some studies have illustrated the effect of early childhood education on increased tax revenues from increased earnings of participants themselves and from future generations due to higher educational attainment that can be attributed to early childhood interventions (Campbell, et al., 2002; Nores, et al., 2005; Oppenheim and MacGregor, 2002; Sum, et al., 2008).

The Technical Appendix describes the studies used in this analysis, the parameters applied, and the estimated cost savings different categories generated per dollar of investment in school readiness.

Assumptions in the analyses

- The analyses in this study estimate benefits and cost savings for various Minnesota government systems, including K-12 education, criminal justice, welfare/public assistance, Medicaid, unemployment, child welfare, and health care.

- Estimates of saved costs are based on actual rates for the various conditions or population characteristics and cost data from St. Paul, Ramsey County, and the state of Minnesota whenever possible.

- The study focus is on 4-year-old children served by the PEK program at school sites.

- The total number of children used to compute benefits and savings is 967. These children include three cohorts of PEK participants that were assessed through 3rd grade. This sample includes most but not all children who have participated in the program (Mueller, Gozali-Lee, Mohr, and Maxfield, 2012).

- Potential benefits of PEK are estimated based on three scenarios: 1) A full impact scenario where benefits are computed using undiscounted effect sizes from the literature on the impacts of ECE. This scenario assumes that PEK has the same level of impact that other ECE programs reported in the literature have, such as the Child Parent Center in Chicago, High/Scope Perry Preschool, and Abecedarian; 2) A medium impact scenario, computed assuming that PEK's impact is 50 percent lower than other ECE programs reported in the literature; and 3) A break-even scenario where the impact of PEK is at the level required to pay back the investment made in the program. These scenarios are constructed to estimate the benefits of PEK based on different levels of potential effectiveness of the program.

- The ROI is calculated using present values of future benefits, savings, and costs; these streams of resources are discounted using a rate of 4 percent. The use of present values allows us to compare values that accrue in different time periods, "the basic notion is that a sum of money equal to a given present value could grow into an amount equal to the future value that was discounted, if it grew at the interest rate used in the calculation in a compounded manner" (Martin, Lotspeich, and Stark, 2012, p. 8). A 4 percent discount rate is relatively high, yet it makes the ROI results more conservative than a lower rate, closer to the rate yield by publically issued bonds.

Potential benefits using the full impact scenario

This section estimates the lifetime cost savings and revenues that could potentially be generated from adequately preparing for kindergarten the 967 participants in PEK. These benefits are estimated under the assumption that PEK is as effective as other major ECE programs. The cost savings and revenues estimates fall into three categories:

K-12 schools – through reduced special education and grade repetition.

State government – through reduced costs of dealing with juvenile and adult criminals; through lower welfare, Medicaid, and unemployment costs; and through higher tax revenues as successful students become productive adults.

The public – through reduced juvenile and adult crime victimization and costs due to injuries and property losses, reduced alcohol and drug abuse costs, and higher future personal income and tax revenues from better prepared children.

These estimates are based on actual school graduation and expenditure data, poverty rates, crime rates, and other data for Saint Paul and the state of Minnesota as a whole and ECE program effect sizes and parameters from the existing research on effects of early childhood education as shown in the technical appendix.

Estimated cost savings for K-12 education

Special education

About 12 percent (113) of PEK participants (967) required special education during their participation in the program. We assume that in absence of the program, all of these 113 children would receive special education for most of their future student careers. In addition, we assume that ECE has an average impact on the incidence of non-cognitive disability of 13 percent (Aos, 2004). Using this effect size we estimate that 14 of these students are less likely to receive further special education after participation in the program. Given the cost of special education per student in St. Paul of $15,393, we compute the potential lifetime savings from reduced special education expenditure for PEK participants that are less likely to receive special education during the period to be $2.4 million (Figure 2).

2. Lifetime costs savings of special education

PEK participants	967
Total special education participants (average 12%)	113
Number of children that will not require special education	14
Special education expenditures per student (St. Paul)	$15,393
Annual savings from reduced special education expenditures	$217,268
Lifetime savings from reduced special education expenditures (millions)	**$2,4**

Grade retention

The average reduction in grade repetition resulting from participation in early childhood education found in the literature is 33 percent. This reduction times the probability of being retained in a given school year in Saint Paul gives the estimated probability of a child not repeating a grade due to ECE. We estimate this probability based on retention data available from the Minnesota Department of Education. Applying the reduction in the probability of being retained to the annual average total expenses per pupil ($15,681) we obtain the estimated annual savings on grade retention per child who participates in ECE. The lifetime savings are based on the reduced probability that the participant is retained in any of all grades of his student career and discounted using a rate of 4 percent.

The total potential lifetime savings for PEK participants due to reduced grade repetition amounts to $610,644 (Figure 3).

3. Lifetime costs savings of reduced grade retention per additional at-risk child in ECE

Average percentage of students retained between grade 1 and 8 in St. Paul	1.17%
Reduction in grade retention rate due to ECE (per student)	-0.00389
Average total expenses per pupil in St Paul	$15,681
Total annual cost savings on grade retention due to ECE	$61
Lifetime cost savings on grade retention due to ECE	$632
Total lifetime savings from reduced grade retention due to PEK (millions)	**$0.6**

Summary of estimated cost savings for K-12 education

The estimated potential savings to K-12 achieving school readiness for 967 PEK students reaches $3.1 million (Figure 4).

4. Potential lifetime costs savings for K-12 education

Lifetime savings from reduced special education expenditures (millions)	$2.4
Total lifetime savings from reduced grade retention due to PEK (millions)	$0.6
Potential lifetime costs savings for K-12 education (millions)	**$3.1**

Estimated cost savings to state government programs

Criminal justice

The savings from crime reduction of participating children are based on the avoided marginal cost of incarcerating an additional criminal in the future. First, we estimate the marginal cost of incarceration using a 10-year series of total expenses in prisons and the population of inmates in Minnesota and using an average length of incarceration of 4 years; the resulting cost of an additional incarceration is $153,469. We then multiply this present value of an average incarceration cost by the probability of committing a crime at juvenile and adult ages (0.016 for adults and 0.011 for Juveniles); we also apply an assumed probability of conviction to convert the unit of analysis from arrests to incarcerations of 0.5 (this implies that about 50 percent of arrests result in incarceration. The result is a series of expected costs of incarceration of a typical individual in Minnesota during his hypothetical life as a criminal (12 to 65 years of age).

The probability that children commit crimes in the future is reduced 27 percent by ECE (Aos, 2004). Consequently, applying this effect size to the expected present value cost of incarceration, we estimate that the potential lifetime cost savings from an additional conviction avoided for each child participating in PEK reaches $5,813, and a total of $5.8 million for all participants. These savings refer to lifetime savings, including juvenile and adult costs of crime.

5. Potential lifetime costs savings from reduced crime

Impact of ECE on convictions (Aos, 2004)	-0.162
Present value of average incarceration in Minnesota (3 years)	$153,469
Estimated incarceration rate per capita	0.016 (Adults) 0.011 (Juveniles)
PEK savings from reduced crime: juvenile and adult systems (millions)	**$5.8**

Public assistance (state portion of Temporary Assistance of Needy Families - TANF)

Early childhood programs can reduce the future usage of public assistance of participants by as much as 39 percent (Schweinhart, et al 2005). We assume that the likelihood of receiving future public assistance of non-PEK participants is equivalent to the proportion of the population that receives public assistance in Minnesota; that is 2 percent of the general population according to the U.S. Census. Using the effect size of the impact of ECE on public assistance participation, we reduced this chance that a participant will receive public assistance by 39 percent.

Given that the average monthly payments of Minnesota Family Investment Program (MFIP) and Medicaid in Minnesota add up to $1,373 per person, the estimated present value of lifetime public assistance costs (including administrative costs, administrative errors, and average number of months in public assistance) is $38,276. Applying the reduced chance of receiving public assistance due to ECE, the savings per ECE participant are $6,231, and the present value of total lifetime savings generated by PEK participants can reach $6 million (Figure 6).

Results include savings from participants who will not receive public assistance and savings from participants who will receive fewer months of public assistance due to their participation in the PEK program.

Child welfare (abuse, neglect, and out-of-home placements)

Comprehensive early childhood education programs that promote school readiness also have been shown to contribute to reductions in child abuse and neglect. The studies we analyzed all showed significant savings in costs associated with child abuse and neglect, averaging reductions of 43 and 39 percent in child abuse and neglect and out of home placement respectively. Given an estimated amount of child welfare costs of $1,939, the total potential lifetime savings for PEK participants during the period studied are $7,550 (Figure 6).

6. Potential lifetime costs savings from reduced public assistance and child welfare

Reduced public assistance (millions)	$6
Child welfare (child abuse and neglect + out of home placement)	$7,550
Total PEK savings from reduced public assistance and child welfare (millions)	**$6**

Minnesota tax receipts

Using data on annual earnings by educational level from the Census Bureau, we estimate that high school graduates in Minnesota earn nearly $8,000 more than dropouts. The net present value of this amount for a productive life is nearly $314,645. Early childhood education can increase the likelihood of high school graduation by 6.2 percent (estimated average from major ECE studies, see Technical Appendix). We estimate, then, that each PEK participant could have $19,371 in additional lifetime earnings; the total after tax additional personal income that 967 PEK participants could generate is $16.5 million.

Using an 11.5 percent effective tax rate for Minnesota for income and sales taxes (Minnesota Department of Revenues, 2011), the additional income of participants in ECE translates to an additional $2.2 million in tax revenues for Minnesota (Figure 7).

7. Potential lifetime costs savings from increased tax revenues

Increase in earnings (millions)	$18.7
PEK Increase in taxes (millions)	$2.2
Net increase in income (millions)	**$16.5**

Unemployment insurance savings

Early childhood participants are more likely to be employed when they reach adulthood. We estimate that the average increase in the probability of being employed for participants is 20 percent higher than non-participants; as a consequence, participants are less likely to receive unemployment insurance. The average length of unemployment episodes in Minnesota is approximately 20 weeks, and the average weekly payment is $347, for an average payment per unemployment episode of $7,234. The total savings for PEK participants is $1,416,073, which is estimated using the average payment per episode times the change in employment for all 967 participants during the period studied (Figure 8).

8. Potential lifetime costs savings from reduced unemployment insurance

Average unemployment insurance payment per unemployment episode in Minnesota	$7,234
Average change in employment of early childhood participants	20.2%
Total savings in reduced unemployment insurance (millions)	**$1.4**

Summary of potential Minnesota state government savings and revenue due to increased school readiness of PEK participants

The potential lifetime savings and revenues for state government from the 967 children that received PEK programming reaches $15.5 million (Figure 9).

9. Potential lifetime costs savings and benefits for Minnesota's budget

Savings from reduced crime (juvenile and adult systems) (millions)	$5.8
Savings from reduced public assistance and child welfare (millions)	$6
Increase in taxes (millions)	$2.2
Savings in reduced unemployment insurance (millions)	$1.4
Total Minnesota's savings and revenues (millions)	**$15.5**

Estimated social cost savings

This section estimates potential social costs savings based on actual expenditures in Minnesota, program participation, and program effect sizes and parameters from research literature.

Crime victimization

Crime victims suffer tangible losses that constitute social costs. ECE has been shown to reduce criminal behavior of participants and thus reduce victims' costs. Reynolds, et al (2011) estimate victim's cost to be at least 4.5 times justice system costs; this amounts to $10,623 in reduced victim's cost per PEK participant. The total savings from reduced crime victim's costs is $10.2 million.

Health (alcohol abuse and drug use)

Children who participate in comprehensive early education programs are 24 percent less likely to present problems of alcohol and illicit drugs abuse (Reynolds, et al 2011). The

annual cost per person can reach up to $5,015 per participant, with total savings from all PEK participants of $15.6 million.

Individual net income

Children who participate in comprehensive early education programs may earn higher income due to their increased educational achievement. From the estimation of additional tax revenues in the previous section we know that this increased lifetime income can reach $11.8 million once revenues from public assistance and taxes are deducted.

Summary of estimated social benefits and savings and revenue

The estimated potential social savings for the 967 PEK participants reaches $37.7 million (Figure 10).

10. Potential lifetime social savings

Estimated annual crime victim saving- juvenile and adult system (millions)	$10.3
Substance abuse (millions)	$15.6
Additional individual net lifetime income (after taxes and cash transfers) (millions)	$11.8
Estimated social savings due to increased school readiness (millions)	**$37.7**

Summary of total lifetime value due to school readiness of PEK participants

The total lifetime value for society of gaining school readiness for PEK participants is about $56 million. As shown in Figure 11, more than 66 percent of the value is generated through social gains.

11. Estimated total lifetime value of school readiness for PEK participants

Cost savings category	Savings/Benefits
K-12 education (millions)	$3.1
Minnesota's state government (millions)	$15.5
Social benefits (millions)	$37.7
Total potential lifetime savings (millions)	**$56.3**

From the perspective of Minnesota taxpayers, PEK can potentially produce savings and benefits of $18.5 million (K-12 savings plus state's government savings). It is assumed that private funders expect the program to generate benefits for participants and other sectors of the society; netting out the benefit for taxpayers, these benefits could reach $37.7 million.

12. Potential total lifetime benefits

	Society	Total savings for taxpayers	Private Funders (McKnight Foundation)
Potential total benefits (millions)	$56.3	$18.6	$37.7

Cost of Project Early Kindergarten

Funding (From evaluation report)

The program operates primarily through funding from Saint Paul Public Schools' referendum and The McKnight Foundation. In 2004 The McKnight Foundation provided a three-year, $2.8 million grant for program development and implementation, and in 2007 McKnight contributed an additional $3 million for efforts through the 2009-10 school year.

PEK extends the program to child care settings through a partnership with Think Small - Leaders in Early Learning (formerly Resources for Child Caring). The Minnesota Early Learning Foundation also contributed funds to the child care portion of the program in the 2007-08 and 2008-09 school years.

In addition, from 2006-07 to 2009-10, PEK-Early Reading First provided funds at two of the PEK schools and two other child care centers under a federal grant. Wilder Research conducted a separate evaluation of the PEK-Early Reading First program. Following completion of the Early Reading First grant, those schools and child care centers continued to participate in the PEK program.

Total Costs of PEK

In Figure 13 we show the total costs of PEK and the portion of them coming from private sources (Foundation grants) for the period between 2005 and 2008 (Cohort 1 through Cohort 3). Private funds accounted for nearly 49 percent of the total cost.

13. Total costs of PEK

	Total Costs (millions)	Private funds (millions)
	$11.6	**$5.7**
2005-06	2.7	1.8
2006-07	2.9	1.5
2007-08	2.9	1.1

Potential Return on Investment of PEK

Throughout the analysis we have assumed that the outcomes of PEK are comparable to other early childhood education programs that have been previously evaluated. Based on this assumption, we have applied effect sizes from the relevant literature on the impacts of early childhood to PEK participation data and other Minnesota data. However, early childhood programs may differ in many ways: methodologies, curricula, intensity, targeted demographics, etc. Therefore, the one-on-one equivalence of impacts may not reflect the true value of the outcomes of PEK. Due to this difficulty, we estimate potential return on investment under three scenarios to account for likely differences between PEK and other programs from which we have taken impact parameters:

- A full impact scenario with undiscounted benefits, that is, benefits are calculated assuming that PEK generates outcomes of about the same magnitude as those ECE programs highlighted in the literature. This is the starting assumption we used to estimate all the benefits in the previous sections.

- In the discounted impact scenario, we assume that PEK generates benefits that are 50 percent lower than the highlighted ECE programs. That is, PEK is only half as effective as other major ECE programs such as Perry Pre-school or Abecedarian.

- The break-even scenario shows the minimum impact that is required for PEK to recover its costs. That is, how effective PEK must be to payback the investment made on it.

Figure 14 contains the resulting potential ROI for the three scenarios and from the three relevant perspectives: The society, taxpayers, and private funders (mainly The McKnight Foundation). The full impact scenario shows a return for the society of 4.8 dollars for every dollar invested. The return to taxpayers is 3.4 dollars and 6.1 dollars for private funders.

If PEK is only 50 percent as effective as other ECE programs, the society will recover 2.4 dollars for every dollar invested in the program, while taxpayers would recover 1.7 dollars, and private funders 3.1 dollars.

The break even scenario shows that PEK only needs to be between 17 and 30 percent as effective as the major ECE programs evaluated in the literature to be able to generate enough benefits to payback the investment that the society made in it. For example, from the taxpayers perspective, PEK needs to produce benefits in the order of $5.5 million to generate an ROI equal to 1; this means that to payback the investment of taxpayers, PEK needs only to be 30 percent as effective as other major early childhood programs highlighted in the literature.

14. Potential return on investment of PEK

Full impact scenario: returns using major early childhood education outcomes			
	Society	**Taxpayers**	**Private Funders (McKnight Foundation)**
Potential total savings (millions)	$56.3	$18.6	$37.7
Cost (millions)	$8.6	$4.1	$4.5
ROI	6.6	4.6	8.4
Discounted impact scenario (50% discounted benefits)			
Potential total savings (millions)	$28.2	$9.3	$18.9
Cost (millions)	$8.6	$4.1	$4.5
ROI	3.3	2.3	4.2
Minimum impact scenario to recover investment (break even)			
Relative discount	**15%**	**22%**	**12%**
Potential total savings (millions)	$8.5	$4.1	$4.5
Cost (millions)	$8.5	$4.1	$4.5
ROI	1.0	1.0	1.0

Return on Investment based on actual outcomes

The majority of the economic effects that PEK will have on participants and the society will materialize in the future as participants grow up and live more productive and healthier lives. The scope and design of the outcome evaluation of the program does not allow generating the required parameters to compute most of these future economic outcomes. That is why we computed the potential ROI of PEK in the previous section based on the assumption that PEK will have similar results to other early childhood programs evaluated in the literature. However, the outcome evaluation of PEK shows a significant improvement in standardized math tests in third grade for the third cohort of participants. Since improved academic performance in math scores has been shown to be associated with higher future annual income of students (Hanushek, 2004), we can estimate the additional future income that PEK participants will earn based on their improved math scores. Based on this outcome and the estimated future benefits, we compute an estimated ROI. This is a partial ROI since it only accounts for one source of benefits. Note that this partial ROI should not be compared to the potential ROI estimated in the previous sections because the two estimations are based on different assumptions. However, we believe that the partial ROI provides a complementary measure of the potential economic impact of the program.

Projected increased lifetime income

Hanushek (2004) states that an increase of one standard deviation in standardized math scores can potentially raise individual annual income by approximately 12 percent. However, since Hanushek's parameter refers to average scores for the whole student career (K-12), and PEK's results are only for 3rd grade, we use a reduced parameter of the increased in lifetime income of 9 percent for every standard deviation improvement in math standardizes scores of PEK participants (a 75% reduction from Hanusheck's parameter). From the PEK outcome evaluation (Mueller, Gozali-Lee, Mohr, and Maxfield, 2012) we know that the third cohort of the program showed an increase in the MCA math test in third grade of two-thirds of a standard deviation over the comparison group (68%). The resulting change in annual income attributed to PEK's impact on standardized scores is 6.1 percent (0.68x0.09).

The data from the Census shows that the median earnings in the past 12 months is $36,282; the additional annual income generated by the 6.1 percent impact of the PEK results in an annual income of $38,502, a difference of $2,220 for PEK participants. Projecting this additional annual income for the productive life of participants (18-65 years of age) and discounting it to present value to age 8, we obtain an increased lifetime income of $39,857. The total personal lifetime earnings for all 312 Cohort 3 participants of the program could reach $12.4 million.

Projected increased tax revenues

Based on the additional lifetime earnings computed above and the effective tax rate of 11.5 percent, we estimate that PEK participants (Cohort 3 only) will pay approximately $1.4 million in additional taxes during their productive life.

Return on Investment from projected increased income and tax revenues

The benefits computed above refer only to PEK Cohort 3 children. These children received services during the 2007-2008 school year. Given the investment made by taxpayers and private funders during that year, we summarize the return on this investment in Figure 15.

15. Return on investment of PEK based on actual outcomes

	Society	Taxpayers	Private Funders (McKnight Foundation)
Benefits	$13.8	$1.4	$12.4
Cost	$2.9	$1.8	$1.1
ROI	4.7	0.79	10.9

The benefit for the society is $13.8 million which consists of $12.4 million in personal earnings plus the $1.3 million in additional taxes paid by participants. The cost to society includes taxpayers' investment and private funders' contribution to the program during the 2007-2008 school year. The ROI for the society is 4.7 dollars for every dollar invested. Taxpayers can potentially expect to recover only 79 cents for every dollar invested in PEK in a period of about 47 years; while private funders' investment can be interpreted as a leverage to improve the productivity of participants who receive 10.9 dollars in return for every dollar invested by private foundations in PEK. However, note that these benefits and the resulting ROIs refer only to a third of the participants and do not include savings and revenues from other positive outcomes that PEK may generate. Therefore, these are conservative estimates based on a partial accounting of all possible benefits of the program. On the other hand, the improved academic scores used come from the 3rd cohort of the program, which is believed to represent PEK at its full strength.

Technical appendix: Study methods and underpinning research

Rates and cost data used in the study calculations

Figure 16 shows the rates for the various conditions or population characteristics and the cost data used in the study calculations. The data sources are also shown.

16. Summary of rates and methodology

Cost category	Impact of ECE	Source of impact	Cost measures	Source of costs	Target population	Methodology
K-12 special education	13% reduction in incidence of non-cognitive disabilities	Adjusted effect size from Aos, et al. (2004)	Special Ed Expenditures per student	MN Department of Education	Average incidence rate of non-cognitive disabilities in all school districts	1. Effect size of ECE reduces incidence rate of non-cognitive disability. 2. Cost of special education per student is applied to the reduced incidence of disabilities
K-12 grade repetition	33% reduction in students who have been retained at least once	Average of four major studies (CPC, Perry, Abecedarian, MSRP)	Total expenditure per student: $12,593	MN Department of Education	Average percentage of students retained between grade 1 and 8	1. Effect size reduces likelihood of repetition. 2 Average reduced rate of repetition in every year of assumed educational career (ages 4-19) is multiplied by average expenditure per student and transformed in present value
Juvenile and adult justice system	16.3% reduction in percentage of participants with arrests	Adjusted effect size from Aos, et al. (2004)	Annual Marginal Operating Cost of an additional individual incarcerated in MN: $44,414 Calculated using expenses and annual populations of all institutions in the state	MN Department of Corrections	Arrests per capita in MN	1. A cross section regression for fiscal years 1997 - 2010 was estimated using DOC correction expenses and annual populations of all institutions in the state of MN. 2. It is assumed a 3 year incarceration period on average (MN's average is 42 months). 3. Effect sizes are applied to the estimated cost of incarceration and adjusted by the probability of being arrested before 18 years old for juvenile and after 18 years old for adult. All values are present value for assumed criminal careers

16. Summary of rates and methodology (continued)

Cost category	Impact of ECE	Source of impact	Cost measures	Source of costs	Target population	Methodology
Public assistance (state portion of TANF)	39% reduction in percentage of ECE participants who had public assistance at age 27	Estimated effect size from Perry School study (Schweinhart, et al. , 2005)	Averge monthly payments (MFIP and Medicaid): $1,373	MN Department of Human Services (DHS)	Percentage of MN population ages 18-27 with public assistance in 2010.	Results include savings from participants who do not receive PA and savings from participants who receive fewer months of public assistance PA. A scale up parameter (48%) is used to account for ECE targeting at risk youths that are more likely to receive PA in the future.
Revenues from taxes	9% estimated increased graduation ratio	Estimated effect size from Reynolds, et al. (2011)	Average effective tax rate (total state and local taxes): 11.5%	Minnesota Revenue	ECE participants	1. Effect sizes are applied to HS and college graduation rates to determine change in likelihood of graduation due to ECE. 2. Difference in lifetime income between HS and no-HS are computed using Census data and then adjusted by the changed probability of graduation. 3. Effective tax rates are applied to the additional lifetime income and the resulted time series is discounted at 4% rate.
Unemployment Insurance	20% reduction in Unemployment Insurance usage	Average of three major studies (CPC, Perry, Abecedarian)	Average weekly payments in MN: $347. Average duration: 20.2 months. Total payment/ person: $7,012	U.S. Department of Labor	ECE participants	Assumes only one unemployment episode. The episode will last the average duration of UI payments in MN. The effect of ECE is independent of the overall economic conditions, i.e. general or local unemployment rates.

16. Summary of rates and methodology (continued)

Cost category	Impact of ECE	Source of impact	Cost measures	Source of costs	Target population	Methodology
Estimated annual crime victim saving-juvenile and adult system	Assumed to be 4.5 times justice system costs (Reynolds; Greenwood, Karloy, etc.)					
Substance abuse	24% reduction in incidence of addiction	Reynolds, et al. (2011)	NPV of costs associated with substance abuse: $62,212	Based on Cohen (1998)	ECE participants	We follow Reynolds' (2012) methodology (based on Cohen 1998)
Additional individual net lifetime income (after taxes and cash transfers)	9% estimated increased graduation ratio	Estimated effect size from Reynolds et al. (2011)	NPV of difference in lifetime earnings between HS and non-HS graduates	U.S. Census	ECE participants	Same as in estimation of taxes

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