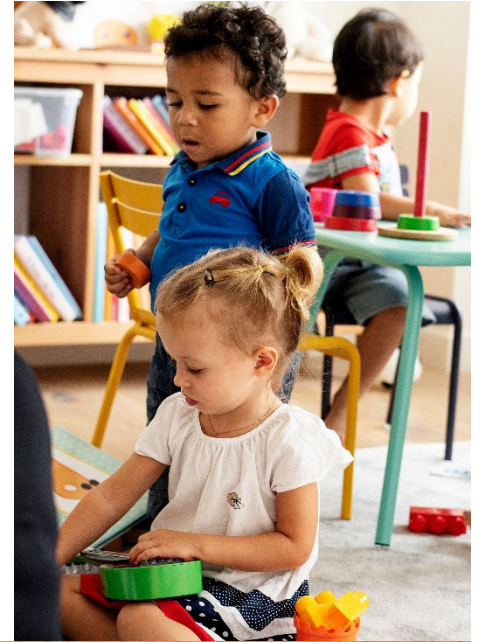


Cost Savings of Early Childhood Education in Michigan

The Value of Getting One Child Ready for Kindergarten

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Preface

In 2011, the Max M. & Marjorie S. Fisher Foundation funded the original version of this study with the purpose of demonstrating the economic value of investing in early childhood education (ECE) in the city of Detroit and in the state of Michigan overall. Wilder Research conducted the study using the most current evidence of impacts and relevant data available at that time. Since then, research has continued to advance, and we now have a more complete sense of the long-term outcomes associated with ECE, along with the best ways to compute the monetary benefits generated by those outcomes. The estimates were computed for a second time in 2014-2015, when Wilder incorporated a number of methodological updates to match best practices at that time. In 2019, the promoters of the original study asked for an update of the 2015 report to reflect the most recently available data and methods, the results of which are summarized in this report.

In this report, we continue to apply the general principles of the model developed by the Washington State Institute of Public Policy (latest version released in 2019). This model is one of the field's most advanced and recognized approaches to computing indirect benefits of social programs (Hirsch, 2019). We have updated a number of the parameters to match current best practices. We have also updated results to reflect the most recently available demographic and economic information, using census and administrative data.

The Value of Getting One Child Ready for Kindergarten

Cost Savings of Early Childhood Education in Michigan

Research studies have demonstrated that effective early childhood education (ECE) programs prepare young children cognitively, physically, socially, and emotionally for success in school, and are particularly valuable for disadvantaged children. Effectively preparing children for kindergarten reduces needless public spending throughout the education, social service, and legal systems, and increases future state revenues by lowering high school drop-out rates and promoting a skilled workforce that contributes to the tax base.

Potential per-child lifetime cost savings due to early childhood education

The public benefits of ECE for one disadvantaged child in Detroit include over \$11,000 in savings to the legal system (nearly \$8,000 for a child in Michigan as a whole) due to the impact of ECE on felony arrests. Reduced criminal activity also reduces harm suffered by victims of crime, with avoided costs totaling over \$24,000 per disadvantaged child in ECE in Detroit and over \$16,000 per disadvantaged child in ECE in Michigan overall.

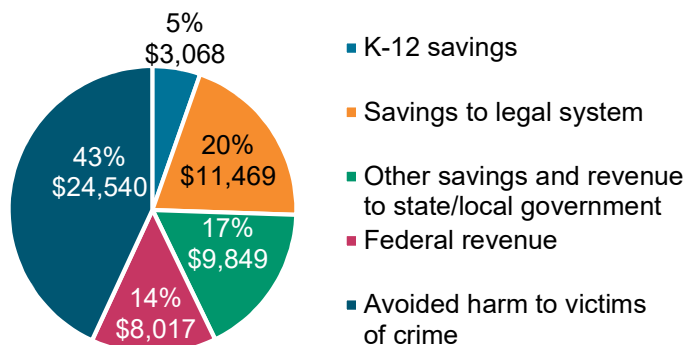
In addition, because of increased educational attainment resulting from ECE, each enrolled disadvantaged child in Detroit will eventually (in adulthood) contribute almost \$6,000 in additional state and local taxes. A disadvantaged child enrolled in ECE in Michigan overall will contribute an extra \$4,500 in state taxes as a result of ECE. Each child enrolled in ECE will also ultimately pay more than \$8,000 in additional federal taxes as a result of ECE, and their reduced need for various public programs will reduce state and local costs by about \$4,000.

The lifetime economic value of early childhood education for one disadvantaged child in Detroit, Michigan is an estimated \$201,000, including nearly \$57,000 in public benefits (i.e., savings and revenue to state, local, and federal government, as well as avoided harm to victims of crime) and \$144,000 in individual benefits to each ECE participant and their family. For one disadvantaged child in Michigan as a whole, the estimated value of ECE is also an estimated \$201,000, but it is distributed differently, with \$42,000 in public benefits and \$158,000 in individual benefits per child.¹

A. PUBLIC BENEFITS OF EARLY CHILDHOOD EDUCATION

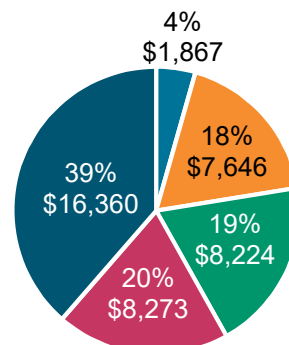
Detroit

Public benefits per child: **\$56,944**



Michigan

Public benefits per child: **\$42,370**



¹ Although the estimated public benefits of ECE exceed the estimated costs of ECE by a ratio of at least 4 to 1, some of the estimated benefits are lower than those reported in 2015 and 2011. This change does not indicate that the value of that ECE-related outcome is lower now than it was in 2015 or 2011. It simply indicates that we have incorporated the latest literature and current data for Michigan and Detroit, resulting in more conservative estimates of benefits.

Research has shown that early childhood education enhances educational attainment, improves mental health, and reduces the incidence of maladaptive behaviors like substance abuse and criminal activity. These benefits produce substantial economic value to society.

Setting aside the gains to participants and their families, the public benefits of ECE still total almost \$57,000 for one Detroit child in ECE, and more than \$42,000 for one Michigan child in ECE (returns of \$7.25 and \$5.40 per dollar invested, respectively). If we increase the rates of ECE participation by just one percentage point, the net benefits to society (after accounting for ECE costs) would add up to \$13 million in Detroit and \$187 million in Michigan overall. The implications of these results are clear: investing in quality early childhood education makes economic sense.

Society as a whole reaps over \$200,000 in benefits from one child participating in ECE in Detroit or in Michigan overall. Assuming an average ECE cost of \$7,850 per child, the total returns to society are over \$25 per dollar invested.

If an additional 1% of 4-year-olds in...	
DETROIT (90 4-year-olds)	MICHIGAN (1,180 4-year-olds)
participated in early childhood education, the net gains to society would add up to:	
\$17.4 MILLION	\$228 MILLION
including:	
\$4.4 MILLION	\$41 MILLION
in public benefits, along with...	
\$13 MILLION	\$187 MILLION
in benefits to participants and their families.	

B. ESTIMATED LIFETIME SAVINGS PER DISADVANTAGED CHILD IN ECE

Cost category	Detroit	Michigan
K-12 savings due to reduced need for special education and grade repetition	\$3,068	\$1,867
Savings to legal system	\$11,469	\$7,646
State and local income tax revenue	\$5,869	\$4,515
Other state savings (child care subsidies, public assistance, child welfare, unemployment insurance)	\$3,980	\$3,709
Total savings and revenue to state and local government, including K-12 system	\$24,387	\$17,736
Avoided harm to victims of crime	\$24,540	\$16,360
Federal income tax revenue	\$8,017	\$8,273
Total public benefits per child in ECE	\$56,944	\$42,370
Increased earnings for ECE participants (in adulthood) and their parents ^a	\$103,096	\$130,229
Savings and avoided mortality due to reduced tobacco use, substance abuse, and depression	\$41,110	\$28,128
Total private benefits (to participants and their families)	\$144,206	\$158,357
Total per-child lifetime benefits	\$201,151	\$200,727

Note. These results show the potential economic benefits associated with one disadvantaged child receiving ECE at the same quality and intensity as the ECE programs represented in the literature. The reported estimates are present values, discounted at a 3% discount rate. All estimates are in 2019 U.S. dollars.

^a Estimated federal, state, and local taxes have been subtracted from the value of increased earnings to ensure that their value is only counted once.

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Introduction

Purpose of this study

This study demonstrates the economic value of investing in early childhood education (ECE) for one disadvantaged child in Michigan, including the benefits to state government and to the public, as well as some of the benefits accruing to the participants themselves. Much of this value takes the form of avoided costs. For example, children who attend preschool require less special education, are less likely to repeat a grade, are more likely to graduate high school, and have less involvement in the legal system. As adults they earn higher incomes, contribute more in taxes, and are more likely to be employed. ECE saves money in the K-12 educational system, legal system, and social welfare system.

Moreover, if a higher proportion of children in Detroit attend comprehensive preschool in future years, the state's annual savings will grow. Conversely, by not investing more fully in the early education of young children, the annual cost burdens, lost earnings, and lost tax revenues will grow.

Most of the benefits in this study are computed based on principles drawn from the Washington State Institute of Public Policy's cost-benefit model (Hirsch, 2019). Their technical documentation outlines the principles and best practices for benefit-cost analysis of an intervention based on the empirically established impacts of the intervention on its participants.

Overview of early childhood education cost-benefit literature

Many studies show that high-quality early learning experiences pay off in the long run (Delalibera & Ferreira, 2019; Elango et al., 2015; Ehrlich & Kornblatt, 2004; Friedman, 2004; Garcia et al., 2017; Heckman, 2010; Karoly et al., 2005; Karoly, 2016; Lynch, 2007; Ramon et al., 2018; Reynolds et al., 2011; Reynolds, 2007; Rolnick & Grunewald, 2003; Temple & Reynolds, 2005). Most of the public return on investment of ECE is in the form of reduced public costs associated with crime and incarceration, public assistance, and child welfare, while participants personally benefit from increased education and earnings.

A number of studies focus specifically on measuring the effects of early childhood interventions and quality early care and education on school systems, including the time spent in K-12 special education and special education spending (Anderson et al. 2002; Barnett, 1995; Conyers et al., 2003; Harvey, 2006; McCoy et al., 2017; Muschkin et al., 2015; Nores et al., 2005; Reynolds, 2007; Schweinhart et al., 2012).

Other studies focus on the impact of early childhood education programs on other areas of government spending, including legal systems, public assistance, Medicaid, unemployment, child welfare, health care, and child care (Aos et al., 2004; Conti et al., 2014; Garcia et al., 2019; Mann & Reynolds, 2006; Nores et al., 2005; Oppenheim & MacGregor, 2002; Reynolds et al., 2002).

Finally, some studies have illustrated the effect of early childhood education on increased tax revenue from increased earnings of participants themselves when they reach adulthood, due to higher educational attainment that can be attributed to early childhood interventions (Campbell et al., 2002; De Haan & Leuven, 2016; Nores et al., 2005; Oppenheim & MacGregor, 2002; Sum et al., 2008).

This body of literature continues to grow and our understanding of the impact of ECE continues to improve. In this report, we use current best practices, drawing from a number of the studies listed above to generate the most up-to-date estimates of the value of ECE in Detroit and in Michigan as a whole.

Assumptions and general approach

The analyses in this study estimate benefits and cost savings for various Michigan government systems, including K-12 education, legal, public assistance, unemployment, child welfare, and child care. The estimates in this report are based on the following general assumptions:

- Estimates of saved costs are based on actual rates for the various conditions or population characteristics and cost data from Detroit and Michigan whenever possible. In the rare case when Michigan and Detroit data are not available, we use national averages or another appropriate proxy.
- The study focuses on children ages 3 to 5 who are classified as “disadvantaged” and who have not been served through the state’s early childhood programs. As a result, the assumed effects of ECE are based on studies focused on the benefits to “disadvantaged” or low-income children.
- In estimating the economic returns associated with ECE, we assume that Michigan’s ECE programs provide services at the same level of quality as those programs observed in the literature. Costs and benefits will vary across ECE programs depending on the quality and intensity of ECE programs, the demographic characteristics of the population served, and the local social and economic conditions.
- When economic benefits are expected to occur in the future, we adjust all figures to present value, denominated in 2019 U.S. dollars, assuming a 3% discount rate.¹

¹ Discounting is explained in detail below, in a section entitled, “What are “discounted” value estimates?”

It is important to note that these estimated benefits of ECE are conservatively low, for several reasons.

- Many of the potential benefits of ECE have not been quantified yet, and some may not be quantifiable. Others are quantifiable but cannot be (or at least, have not been) assigned a dollar value. Ultimately, we are only able to capture a subset of the likely benefits of ECE.

For example, numerous studies have demonstrated the impacts of ECE on test scores and IQ (Elango et al., 2015), but the monetary benefits of these gains cannot usually be captured directly (though they drive gains in other observed impacts, such as educational attainment).

- In the existing literature, many of the estimated effects of ECE are likely to be underestimated because the research teams generally cannot prevent their control groups' parents from enrolling their children in another ECE program. As a result, the control group may include some students who are benefiting from ECE, which makes the observed effects of ECE in the treatment group appear smaller.
- In following best practices in ROI analysis, our approach aims to consistently err on the conservative side.

Compared to the 2015 iteration of this study, the estimated benefits in this report are based on more conservative estimates of the effects of early childhood education on outcomes in adulthood, resulting in lower estimates of the benefits of ECE. At the time of the previous study, the most recent available effect sizes were developed by Reynolds et al. (2011). Since then, Elango and colleagues compiled the results from several longitudinal studies on the subject, then replicated the analyses using a consistent approach across the different datasets (Elango et al., 2015). Their estimated effect sizes tend to be smaller than those of Reynolds et al. (2011), but they incorporate the results of several longitudinal studies and, in our opinion, their analysis is of very high quality, completed by several leaders in the field. As we see no scientifically legitimate reason to dismiss these more recent estimates in favor of the older (and less conservative) effect sizes used in our prior report, our conservative approach requires that we use these more recent findings. We thus draw as many effect sizes as possible from the most comprehensive recent source of effect sizes that we were able to identify (Elango et al. (2015), and the studies cited therein). Figure A2 in the Appendix presents a comparison of the effect sizes used in this report and the prior one.

In the following sections, we review the ECE benefits that we are able to quantify and monetize, including our approach to estimating the monetary value and the parameters and data sources used to generate the estimates.

Estimated public benefits per child in early childhood education

This section estimates the lifetime cost savings within the city of Detroit and for Michigan overall as a result of early childhood education. The estimated benefits fall into four categories:

- **K-12 schools** – through reduced special education and grade repetition costs
- **State and local government** – through reduced crime, through lower costs of public assistance and unemployment benefits, and through higher tax revenues as successful students become productive adults and as the children’s parent(s) increase their productivity when their children are occupied at ECE
- **The public** – through reduced crime victimization and associated costs due to injuries and property losses
- **ECE participants and their families** – through increased income, lower mortality risk due to reduced tobacco use, and avoided costs of treatment for depression and substance abuse

These estimates are based on actual school graduation and expenditure data, poverty rates, crime rates, and other data for Detroit and for Michigan as a whole, paired with ECE program effect sizes and parameters from the existing research on the effects of early childhood education.

Estimated cost savings for K-12 education

Special education

In the 2017-18 school year, nearly 7,000 children in Detroit Public Schools and more than 177,000 children in Michigan received special education services for a variety of cognitive, developmental, and learning disabilities (Michigan’s Center for Educational Performance and Information [MCEPI], 2018a). Figure 1 shows the estimated per-student annual and lifetime costs of special education in Detroit and Michigan as a whole.² It also shows the percentages of students who require special education, in addition to the assumed impact of ECE.

² Estimated education savings for Detroit are based on the costs, special education rates, and grade retention rates of students in Detroit Public Schools, due to limitations of data availability for other schools in Detroit.

Based on the findings of Elango et al. (2015), we assume that ECE reduces the incidence of special education by 13%. This effect size is relative; when we multiply it by a population-specific “base rate” (i.e., the 16% of Detroit students who require special education) the resulting estimate is an ECE effect that is specific to this population (MCEPI, 2018a). Multiplying 13% by 16%, we compute an estimated effect of 2.1 percentage points. This means that, among Detroit children who attended ECE, about 14% of children will require special education, while 16% of other Detroit children will require special education. Multiplying this locally specific effect (2.1 percentage points) by the estimated lifetime cost of special education per student (\$144,188), we arrive at the estimated lifetime per-child special education costs avoided due to ECE: \$2,976 per disadvantaged child in Detroit, and \$1,795 per disadvantaged child in Michigan overall (Figure 1; Michigan Department of Education [MDE], 2019).

1. Special education incidence, costs, and potential savings per disadvantaged child in ECE

	Detroit	Michigan
ECE impact on the need for special education	13%	13%
Percentage of students who require special education	16%	13%
ECE-related reduction in probability of requiring special education (percentage points)	2.1%	1.8%
Average annual cost per special education student	\$14,485	\$10,204
Per-student lifetime costs of special education (12 years)	\$144,188	\$101,573
Lifetime per-child special education costs avoided due to ECE	\$2,976	\$1,795

Sources: Elango et al. (2015); MCEPI (2018a); MDE (2019)

Notes: The estimated values of all future outcomes are discounted to their present value, from the age at which the outcome occurs. These estimates assume that ECE occurs at age 4 and the potential cost savings (due to reduced need for special education) accrue annually thereafter. These savings are discounted at an annual rate of 3%. Additional details are shown in Figure A3 in the Appendix.

To illustrate our general approach to quantifying the savings generated by ECE, consider the following example of Detroit, using the data in Figure 1. These steps illustrate how the pieces come together to compute the ECE-related savings.

2. Estimated savings to special education (illustration of computation of benefits)

In Detroit, approximately **16%** of students require at least some special education (Figure 1; MCEPI, 2018a). We will refer to this as the base rate of the outcome (**br**).

If a child attended ECE, their likelihood of requiring special education drops by **13%** (Elango et al., 2015). We will refer to this as the effect size (**es**).

In Detroit, we estimate that ECE reduces the probability of a child needing special education by $16\% \times 13\% =$ **2 percentage points**.

In Detroit, special education costs \$14,485 per student per year. Assuming 12 years of special education, and discounting these future costs to their value today, the per-student lifetime cost of special education is **\$144,188** (MDE, 2019). We will refer to this as the value of the outcome (**vo**).

ECE is responsible for a 2 percentage-point change in probability of special education, the cost of which is \$144,188. The value of ECE's impact on special education costs is therefore $(0.02 \times \$144,188)$ **\$2,976** per child in Detroit.

To clarify how the data are used to generate the estimates throughout this report, the symbols **br** **es** **vo** are used to indicate **base rates**, **effect sizes**, and the **value when the outcomes occur**, respectively. In general, unless otherwise stated, we compute:

$$\text{ECE benefits} = \text{br} \times \text{es} \times \text{vo}$$

base rate of outcome
(**br**)

×

effect size of ECE on
outcome (**es**)

=

change in (prob. of)
outcome due to ECE

×

\$ value when
outcome occurs (**vo**)

=

ECE benefits
(value of change in
outcome due to ECE)

Grade repetition

Existing literature shows that ECE reduces the incidence of grade repetition by 24% (Elango et al., 2015).

By multiplying the ECE impact on grade repetition (24%) by the baseline probability of being retained in a given school year, we can compute the estimated probability that ECE will prevent a child from repeating a grade (Elango et al., 2015). We estimate this probability based on retention data available for Detroit and Michigan for the 2017-18 school year (MCEPI 2018b, 2018c).

Applying the reduction in the probability of grade retention to the average annual cost per student, we obtain the estimated savings on grade retention per child who participates in ECE. To be conservative, we assume that a child only repeats one grade (at most) throughout grades K-12.

What are “discounted” value estimates?

Throughout this report, our estimated benefits of ECE have been discounted to their present value, meaning we’ve adjusted our numbers to make it possible to compare costs and benefits on an apples-to-apples basis, even though the costs may occur many years before the benefits.

Why is it a problem to compare current costs to future benefits without discounting?

Similar to comparing values measured in two different currencies, we cannot compare these costs and benefits because one is measured in future dollars, which are less valuable than dollars in the present. ECE reduces a number of costs that would not have occurred until the ECE participant reached adulthood, so these cost savings are not worth as much as they would be worth if they occurred today.

Why aren’t future dollars worth as much?

Given a choice between a gift of \$100 now or \$100 in 10 years, just about everybody intuitively knows that we would rather receive \$100 now.

To illustrate why, consider an example of Jerome and Jada, offered this choice between \$100 now or in 10 years. Jerome opts for \$100 in 10 years and Jada opts for \$100 now. Jada puts her \$100 in a savings account and then forgets about it. In 10 years, Jerome receives his \$100, but Jada’s \$100 has grown well beyond \$100. When comparing current costs and future benefits, we have to account for the reduced value of these benefits that occur years or decades into the future.

We discount all values to present day. We assume ECE participation occurs at age 4.

The estimated savings due to reduced grade repetition are \$92 in Detroit and \$71 in Michigan as a whole (Figure 3).³

3. K-12 costs and potential savings due to reduced grade retention (per disadvantaged child in ECE)

	Detroit	Michigan
br Average percentage of students retained each year	3.8%	2.8%
es ECE impact on grade retention rate	24%	24%
vo Annual K-12 expenditures per student	\$13,958	\$14,259
Annual cost savings on grade retention due to ECE	\$92	\$71

Sources: Elango et al. (2015); MCEPI (2018b, 2018c); MDE (2018)

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs.

Summary of estimated cost savings for K-12 education

Combining the potential savings from reduced need for special education and reduced grade retention, the estimated potential K-12 savings per child sums to \$3,068 for a disadvantaged child in Detroit and \$1,867 for a disadvantaged child in Michigan as a whole.

Additional considerations and issues

It is important to note that there are additional cost savings to the K-12 education system which could result from quality early childhood education but were not included in this analysis, including: 1) reduced use of achievement enhancement and remedial education programs, 2) reduced non-instructional and health costs related to special education and preventable health problems, 3) reduced costs for alternative schools, 4) increased per-pupil aid from parents, and 5) reduced costs of having to provide education to students in juvenile detention. While there is reason to believe that improved school readiness through early childhood education would affect these categories of expenditures, these savings could not be included because there is insufficient existing research to measure or monetize the impact of improved school readiness in these areas.

Finally, due to data limitations, we did not include estimates of savings due to reduced teacher absenteeism and turnover, reduced school safety spending in higher grades, and reduced costs associated with English language learners. To the extent that savings might be realized in all or some of these areas, the estimates presented here underestimate the total savings to the K-12 system.

³ Note that these estimates are considerably lower than the values estimated in the past. This change results from a decline in per-student K-12 expenditures, a drop in the base rate of grade retention, and a lower estimate of the impact of ECE on the need for special education.

Estimated cost savings to state and local government

Legal systems

The state savings from crime reduction are based on the avoided cost of incarceration when ECE reduces the number of felony arrests. From the ECE literature, we know that as the ECE participants grew into adults, they were arrested 0.76 fewer times on average (0.38 fewer among women, 1.14 fewer among men), compared to the control group (Elango et al., 2015).

As overall counts of felony arrests were unavailable, our analysis is based on publicly reported counts of felony cases, i.e., felony arrests for which charges were filed. We estimate that approximately 41% of felony cases in Michigan lead to convictions (Michigan State Courts, 2019; Snyder & Washington, 2019). Of individuals who are convicted, 21% go to prison (for 4.2 years, on average) and 59% go to jail (for 5 months, on average; Michigan State Courts, 2019; Snyder & Washington, 2019). We therefore conclude that ECE results in 0.07 fewer prison terms and 0.19 fewer jail terms per participating disadvantaged child.

Next, we compute the costs for the typical jail term and prison term. It costs an estimated \$26,314 per year to incarcerate one additional inmate in a Michigan prison and \$69,577 per year in a Michigan jail (Snyder & Washington, 2019; Evans, 2017; Evans, 2018). Multiplying these values by the average length of stay in prison and jail, respectively, and then discounting these potential future savings to their present value, we estimate the cost of a typical felony-related jail stay to be \$16,051, and the cost of a typical felony-related prison stay to be \$71,239.

Therefore, when ECE reduces the number of future felony arrests by 0.76 per disadvantaged child in ECE, it leads to 0.07 fewer prison terms at a cost of \$71,239 per prison term. This saves an average of \$4,656 in prison costs per ECE participant in Michigan. We follow the same approach for average jail costs, resulting in an estimated \$2,990 per child in avoided jail costs in Michigan due to ECE. This brings the total avoided incarceration costs to \$7,646 per disadvantaged child in ECE in Michigan overall.⁴

⁴ These estimates are based on the average effect size for men and women (0.76 fewer arrests per ECE participant). ECE has been shown to cause larger reductions in arrests for male participants than females (1.14 fewer arrests for males, 0.38 fewer arrests for females). As a result, the estimated value of ECE's impact on incarceration costs is larger for males (\$17,170 in Detroit, \$11,446 in Michigan overall) than for females (\$5,768 in Detroit, \$3,846 in Michigan overall). The estimated benefits are the simple averages of these two sets of values.

Finally, we adjust the Detroit estimates to account for the higher risk of a felony arrest in Detroit compared to Michigan as a whole. In Detroit, there are about 1.5 times as many felony cases per 100,000 people compared to Michigan as a whole (Michigan State Courts, 2019).⁵ This implies that, on average, a child in Detroit is 1.5 times more likely to be charged with a felony, compared to the average child in Michigan overall. As a result, the potential benefit of ECE for a child in Detroit is 1.5 times greater than that of a child in Michigan overall, a total of \$11,469 (Figure 4).

4. Savings to legal system per disadvantaged child in ECE

	Per-child number of felony arrests avoided	0.76	
		Jail	Prison
	Probability that arrest leads to jail or prison sentence	8.6%	24.5%
es	Per-child number of jail or prison sentences avoided	0.07	0.19
	Length of typical sentence for those who go to prison/jail (months)	50	5
	Cost of prison/jail per year	\$26,314	\$69,577
vo	Total cost of typical jail/prison stay	\$71,239	\$16,051
	Impact of ECE on incarceration costs in Michigan	\$4,656	\$2,990
	Total per-child impact of ECE on prison/jail costs in Michigan	\$7,646	
	Felony cases per 100,000 people - Michigan	1,101	
	Felony cases per 100,000 people - Detroit	1,724	
	Crime ratio Detroit: Michigan	1.5	
	Total per-child impact of ECE on prison/jail costs in Detroit	\$11,469	

Sources: Elango et al. (2015); Evans (2017, 2018); Michigan State Courts (2019); (Snyder & Washington, 2019); Schlueter et al. (2014); U.S. Department of Justice, Federal Bureau of Investigation (2018a, 2018b); Rosenmerkel et al. (2009)

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs.

The base rate (br) is not used to compute savings to the legal system because the impact of ECE is measured as the average number of avoided arrests rather than as a percentage reduction. Adjusting for the base rate is required only when the estimated effect size is relative (i.e., a percentage change).

Annual jail costs are based on Wayne County jail expenditures in FY17 (Evans, 2017) and average daily jail population in Wayne County jails in FY17 (Evans, 2018). Note that FY17 average daily population is shown in the FY18 budget document.

Annual prison costs are based on average daily prison population and total facility-based corrections expenditures in 2018 (i.e., total Michigan corrections expenditures, minus all central and department-wide costs) (Snyder & Washington, 2019).

⁵ 36th Circuit Court (Detroit) reported a caseload of 11,570 felonies in 2018 (*D36 District Court for City of Detroit Summary*, Michigan State Courts, 2019), for a rate of 1,724 felony arrests per 100,000 people. The state of Michigan reported a caseload of 110,043 felonies (*Statewide Circuit Court Summary: 2018 Court Caseload Report*, Michigan State Courts, 2019), a rate of 1,101 felony arrests per 100,000 people.

State and local tax revenue

ECE is known to improve the likelihood of greater educational attainment (high school graduation and completion of at least some college), which leads to increased earnings and corresponding additional tax contributions throughout the child's lifetime (McCoy et al., 2017). In this section, we review the tax revenue associated with these increased earnings, while the "Benefits to Individuals" section (below) offers more detail on the impact of ECE on educational attainment, and the impact of educational attainment on individual earnings.

Due to the increased earnings associated with high school graduation, Detroit high school graduates will pay an additional \$8,205 in state taxes (4.25% flat state income tax) and \$4,633 in local taxes (2.4% flat local income tax in Detroit) on average over the course of their lifetimes (Michigan Department of Treasury, 2018; Michigan State University, n.d.). ECE increases a child's likelihood of high school graduation by 16 percentage points (21% of the 77% base rate); consequently, increased tax revenues due to ECE are \$1,312 in state taxes and \$741 in local taxes (Elango et al., 2015; MCEPI, 2018c). We use the same process to compute the impact of ECE on taxes via high school graduation in Michigan overall, and via completion of at least some college, with an effect size of 14% and base rates of 47% in Detroit and 61% in Michigan overall (Elango et al., 2015;). The results are shown in Figure 5.

5. Increased state and local tax revenues per disadvantaged child in ECE

		Detroit	Michigan
Taxes on increased earnings for ECE participant			
es	ECE impact on high school graduation rate	21%	21%
br	High school graduation rate (2018)	77%	81%
vo	Taxes on increased earnings due to high school graduation	State Local	\$8,205 \$4,633
	Taxes on increased earnings <i>due to impact of ECE</i> on high school graduation	State Local	\$1,312 \$741
es	ECE impact on rate of completing at least some college	14%	14%
br	Base rate of completing at least some college	47%	61%
vo	Taxes on increased earnings due to completion of at least some college ^a	State Local	\$17,781 \$10,041
	Taxes on increased earnings <i>due to impact of ECE</i> on completion of at least some college ^a	State Local	\$1,465 \$828
Total taxes on increased earnings due to ECE impact on post-secondary enrollment		State Local	\$2,778 \$1,569
Taxes on increased parental earnings due to ECE		State Local	\$973 \$549
Taxes on all increased earnings due to ECE		State Local	\$3,751 \$2,118

Sources: Deming (2009); Elango et al. (2015); MCEPI (2018b, 2018c); Michigan Department of Treasury (2018); Michigan State University (n.d.); United States Census Bureau [USCB] (2014); USCB (2018)

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs. Earnings are discounted separately for each year of life in adulthood (e.g., earnings at age 18 discounted 14 years, to age 4, earnings at age 19 discounted 15 years, to age 4, etc.).

^a The earnings increase associated with completion of “at least some college” is computed as the median earnings for people with a high school diploma or GED (weighted average by population), subtracted from the weighted average of the median earnings of those with the following levels of education: some college, but less than 1 year; 1 or more years of college credit, no degree; associate’s degree; bachelor’s degree; professional degree beyond a bachelor’s degree; and doctorate degree.

Finally, as a result of children receiving ECE, their parents' earnings increase as well. After enrolling their children in ECE, parents may have additional time on their hands, and research has shown that many parents use that time to work additional hours or pursue additional education or training (Masse & Barnette, 2002). Parents with children who participate in comprehensive early education programs have higher incomes for many years after their children have completed ECE. Masse & Barnett (2002) estimate that after a child completes a 5-year ECE program, their parent's income increases by an average of \$3,856 per year (adjusted to 2019 dollars) from ages 26-60, for a total lifetime increase of over \$114,000. Because we assume only one year of ECE per child, we assume one-fifth of this increased parental income (\$22,894) per disadvantaged child in ECE.

For each of these sources of additional income for ECE participants and their parents, we multiply the additional income by the 4.25% flat state income tax rate and the 2.4% flat local income tax rate to arrive at the total state tax revenues of \$3,751 per child in Detroit and local tax revenues of \$2,118 per child in Detroit (Michigan Department of Treasury, 2018; Michigan State University, n.d.). In Michigan overall, the additional income generates a total of \$4,515 state tax revenue per child (Figure 5).

Child care subsidies

For many low-income families with children attending publicly funded ECE programs, child care subsidy payments are available. However, families frequently do not utilize the child care subsidies for which they are eligible while their children are enrolled in and attending ECE. Families qualify for child care subsidies in Michigan if their annual family income is at or below 125% of the Federal Poverty Line (Sorenson, 2017). On average, the child care subsidy rate is set at \$6,155 per child per year in Michigan overall, and \$6,527 per child per year in Detroit (Michigan Department of Health & Human Services [MDHHS], 2018).⁶ We assume that half of the families in ECE would use the child care subsidy if their child were not attending ECE, leading to an average per-child savings of \$3,078 in Michigan overall and \$3,263 in Detroit.




Public assistance

Next, we estimate the potential savings from reduced public assistance via the Family Independence Program (FIP), Michigan's cash assistance program for families. ECE has been shown to have a 14% downward effect on the likelihood of any receipt of welfare prior to age 27 (Elango et al., 2015). We assume that 54% of disadvantaged children would use public assistance at some point if not for ECE, based on the observed rate of the control group in Heckman et al. (2010), the study upon which the 14% effect size is based.

⁶ Assumes 20% administrative costs.

The average annual FIP cost per recipient is \$3,104 in Detroit, and we assume receipt of public assistance payments for the full four years allowed in the FIP program (MDHHS, 2018). After discounting the stream of future payments to the present value, the four-year cost is \$6,579 per recipient. Multiplying this by the 14% ECE effect size and the 54% likelihood that children would receive public assistance in the future if not for ECE, we arrive at our estimated savings of \$497 per disadvantaged child in ECE (Figure 6).

6. Savings to public assistance per disadvantaged child in ECE

	Detroit	Michigan
 ECE impact on likelihood of using welfare before age 27	14%	14%
 Assumed % who would use public assistance if not for ECE	54%	54%
Annual FIP expenditure per household (assumes 20% administrative cost)	\$3,104	\$2,923
 Four years of FIP expenditure, per household	\$6,579	\$6,198
Total public assistance savings due to ECE	\$497	\$469

Sources: Elango et al. (2015); Heckman et al. (2010); MDHHS (2018)

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs. For discounting purposes, these estimates assume the public assistance outcome would occur at age 24.

Unemployment insurance

ECE also reduces the cost of unemployment insurance, as increased educational attainment reduces the likelihood that ECE participants will someday make an unemployment insurance claim. By increasing the likelihood of completing high school and some college, ECE reduces the expected unemployment rate for the child when they reach adulthood, and their expected number of periods of unemployment if they are ever unemployed.

We estimate that the lifetime unemployment cost for a person with no high school diploma is \$959 on average, compared to \$341 for those with only a high school diploma and \$161 for those with at least some college. Note that these are not the costs per unemployed person; these are the costs of a small proportion of people who are unemployed, averaged across the entire population (U. S. Bureau of Labor Statistics, 2019).⁷

⁷ Among people who are unemployed at some point, their estimated lifetime costs are \$49,410 with no high school diploma, compared to \$39,650 with a high school diploma only and \$29,376 for those with at least some college (authors' computation based on the 20-week benefit period, the average weekly payout (Stebbins, 2019), and the average number of employment spells per unemployed person (U.S. Bureau of Labor Statistics, 2019). To compute the average cost per person overall, we multiply these estimated costs by 20% (the percentage of unemployed people who receive benefits; Stebbins, 2019) and then by the percentage of people who are unemployed, i.e., the unemployment rate.

Using the costs per person listed above, the average unemployment savings due to high school graduation is \$618. As noted above, ECE increases the probability of high school graduation by 17 percentage points (as shown in Figure 5, 81% graduation rate times the 21% effect size; Elango et al., 2015; USCB, 2018). Multiplying this by the savings due to high school graduation and discounting these future savings to their present value, we find that the ECE-related unemployment savings due to high school graduation are \$58. Following the same process to quantify the benefits of the increased rate of completing at least some college, we find a per-child benefit of \$8. ECE thus generates a total of \$67 of savings per child through increasing their educational attainment and subsequently reducing costs of unemployment.

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

Comprehensive early childhood education programs that promote school readiness have been shown to contribute to a reduction in incidences of child abuse and neglect. We use Reynolds et al. (2011) estimates of the reduction in child abuse and neglect cases and out-of-home placement associated with ECE (43% and 39% reduction, respectively).⁸ In Detroit, the base rate of abuse and neglect is 2.8%, and we estimate the public cost per case of abuse and neglect to be \$9,722 (Rosinsky & Williams, 2018; The Annie E. Casey Foundation, KIDS COUNT Data Center, 2018b). Multiplying these parameters, we estimate an average of \$116 per child in ECE-related savings due to reduced child abuse and neglect in Detroit. We follow the same process to arrive at an average savings of \$37 per child due to reduced incidence of out-of-home placement in Detroit, \$75 per child for reduced incidence of child abuse and neglect in Michigan overall, and \$21 per child due to reduced incidence of out-of-home placement in Michigan overall (Figure 7).

⁸ Although we generally use effect size estimates from other more recent studies, to our knowledge Reynolds et al. (2011) still offers the most recent estimates of the effect of ECE on child welfare system involvement.

7. Savings in child welfare costs per disadvantaged child in ECE

	Detroit	Michigan
es Effect of ECE on incidence of abuse/neglect	43%	43%
br Incidence of confirmed abuse/neglect, ages 0-17 (% of population)	2.8%	1.8%
vo Annual cost per confirmed victim of abuse/neglect (not requiring out-of-home care), ages 0-17	\$9,722	\$9,722
<i>State savings due to reduced incidence of abuse/neglect</i>	\$116	\$75
es Effect of ECE on incidence of out-of-home placement	39%	39%
br Children ages 0-17 in out-of-home care (% of population)	0.8%	0.5%
vo Annual cost per child ages 0-17 in out-of-home care	\$11,510	\$11,510
<i>State savings due to reduced incidence of out-of-home placement</i>	\$37	\$21
Total child welfare benefits to state	\$153	\$96

Sources: Reynolds et al., 2011; Rosinski & Williams (2018); The Annie E. Casey Foundation, KIDS COUNT Data Center (2018a, 2018b)

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs (in this case, 10 years old).

Summary of estimated Michigan state government savings and revenue due to increased school readiness of a disadvantaged child

In total, the state government is estimated to save \$21,318 per disadvantaged child in ECE in Detroit and \$15,870 per disadvantaged child in Michigan as a whole. The greatest savings are in the legal system, where reduced criminal activity enables the state to avoid between \$7,600 and \$11,500 per disadvantaged child in ECE (in Michigan overall and in Detroit, respectively). The increased incomes of ECE participants and their parents also generate several thousand dollars in additional tax revenue for the state and the city of Detroit (Figure 8).

8. Total state and local government benefits per disadvantaged child in ECE

	Detroit	Michigan
Legal system	\$11,469	\$7,646
State income tax revenue	\$3,751	\$4,515
Child care subsidies	\$3,263	\$3,078
Local income tax revenue	\$2,118	-
Public assistance	\$497	\$469
Child welfare	\$153	\$96
Unemployment insurance	\$67	\$67
Subtotal savings and revenue to state and local government	\$21,318	\$15,870

Benefits to the public – avoided harms from criminal activity

When crime occurs, victims suffer both tangible and intangible losses that constitute social costs. For example, victims of property crimes (e.g., burglary) lose items that have value, and victims of violent crime may face costs of medical care (i.e., tangible losses). Victims of crime may also experience emotional harm or reduced quality of life (i.e., intangible losses). When ECE reduces the incidence of felonies, the general public avoids a portion of these costs. Multiplying the reduction in felony arrests per child (0.76) by the average victim cost per felony (\$38,803) and then discounting the future savings to their present value, we find that ECE reduces victim costs by an average of \$16,360 per disadvantaged child in ECE in Michigan overall (Elango et al., 2015; Schlueter et al., 2014).⁹ Adjusting for the higher rate of felonies in Detroit, the avoided victim costs are \$24,540 per disadvantaged child in ECE in Detroit.

Benefits to the public – federal tax revenue

Due to the additional earnings for parent and child (outlined in the “Benefits to individuals” section below), ECE generates a total of \$8,017 in federal tax revenue per disadvantaged child in ECE in Detroit, and \$8,273 in federal tax revenue per disadvantaged child in ECE in Michigan overall.

Benefits to individuals

ECE generates a number of benefits to the participating disadvantaged children and to their parents, including increased earnings and improved health outcomes. Estimated values for some of these benefits are reviewed in this section.¹⁰

Increased lifetime earnings due to higher educational attainment

To determine the impact of increased educational attainment, we use American Community Survey (ACS) data on income by age and educational attainment, specific to the state of

⁹ For discounting purposes, we assume that the criminal activity outcome occurs at age 24. Please see Figure A4 in the Appendix for additional details about how victim costs were computed, as well as the data sources that were used.

¹⁰ There may be a long list of other benefits of ECE to individuals, the general public, and government entities, but we are only able to quantify those that have been rigorously studied in the existing literature. To assess these long-term outcomes of ECE requires decades of follow-up with former ECE participants, which limits the number of studies and thus also limits the number of outcomes for which a significant impact has been established. We have quantified those for which we have found sufficient documentation, but we expect that new findings will continue to emerge, enabling us to capture more of these benefits in our computations.

Michigan and the city of Detroit (USCB, 2014). Using these data, we compute the increased lifetime earnings associated with a high school diploma, starting at age 18 and continuing through age 65. In Detroit, individuals who graduate from high school (and do not complete any college) earn about \$193,000 more during their lifetime than those who do not complete high school. ECE has been shown to increase graduation rates by 21%, and the base graduation rate for Detroit students is 77%, so ECE is expected to increase the graduation rate by $(77\% \times 21\% =)$ 16 percentage points among ECE participants (Elango et al., 2015; USCB, 2018). The expected ECE impact on earnings due to increased high school graduation is therefore \$30,878 per child in Detroit (Figure 9).¹¹

ECE also improves the likelihood of attending college by nearly 14% (Elango et al., 2015). In Detroit, 47% of adults over age 25 have completed at least some college, and the average lifetime benefit of completing at least some college is over \$418,000 (USCB, 2014; USCB, 2018). The ECE impact on earnings due to increased post-secondary educational attainment is therefore \$34,481, for a total ECE earnings impact of \$65,359 per disadvantaged child in ECE.

Using parameters from Hirsch (2019), we assume fringe benefits equal to 44.1% of earnings, with a fringe benefits growth rate of 0.041% per year. This yields an additional \$29,293 in lifetime benefits per disadvantaged child in Detroit. Adding this to the impact on earnings, and subtracting taxes and public assistance and unemployment payments which have been avoided (as shown in the “Public assistance” and “Unemployment” sections above), we arrive at the total per-child net increase in earnings and fringe benefits due to the ECE impact on educational attainment in Detroit of \$84,906.

¹¹ Lifetime earnings are adjusted for expected growth of earnings of 0.5% annually (for those with a high school diploma; WSIPP, 2019), and are discounted to present value using a 3% discount rate. Earnings estimates assume a working life between ages 18 and 65.

9. Increased individual earnings and fringe benefits per disadvantaged child in ECE

	Detroit	Michigan
es Increased earnings for ECE participant via high school graduation		
br ECE impact on high school graduation rate	21%	21%
vo High school graduation rate (2018)	77%	81%
Earnings increase due to high school graduation	\$193,050	\$241,921
<i>Increased earnings due to ECE impact on high school graduation</i>	\$30,878	\$40,383
es Increased earnings for ECE participant via post-secondary educational attainment		
br ECE impact on rate of completing at least some college	14%	14%
vo Base rate of completing at least some college	47%	61%
Earnings increase due to completion of at least some college ^a	\$418,377	\$521,151
<i>Increased earnings due to ECE impact on post-secondary enrollment</i>	\$34,481	\$42,951
Total increased earnings for ECE participant due to increased educational attainment		
Total additional lifetime earnings: ECE participant	\$65,359	\$83,334
Plus additional lifetime fringe benefits ^b	\$29,293	\$37,324
Minus federal taxes	-\$4,835	-\$5,091
Minus state and local taxes	-\$3,542	-\$4,346
Minus public assistance/unemployment payments avoided	-\$564	-\$535
<i>Total net lifetime earnings and fringe benefits: ECE participant</i>	\$84,906	\$111,490
Increased earnings for parent of ECE participant		
Total increased parental earnings due to ECE	\$22,894	\$22,894
Minus federal taxes ^c	-\$3,182	-\$3,182
Minus state and local taxes	-\$1,522	-\$973
<i>Net increased parental earnings due to ECE</i>	\$18,189	\$18,739
Total additional net earnings and fringe benefits (parent and child) per disadvantaged child in ECE	\$103,096	\$130,229

Sources: Deming (2009); Elango et al. (2015); Michigan Dept. of Education (2018); USCB (2014); USCB (2018); Hirsch (2019); Masse & Barnett (2002)

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs. Earnings are discounted separately for each year of life in adulthood (e.g., earnings at age 18 discounted 14 years, to age 4, earnings at age 19 discounted 15 years, to age 4, etc.). With the exception of lines labeled as “net lifetime earnings,” all earnings estimates include federal, state, and local taxes to be paid (i.e., they have not been subtracted from these estimates).

^a The earnings increase associated with completion of “at least some college” is computed as the median earnings for people with a high school diploma or GED (weighted average by population), minus the weighted average of the median earnings of those with the following levels of education: Some college, but less than 1 year; 1 or more years of college credit, no degree; associate’s degree; bachelor’s degree; professional degree beyond a bachelor’s degree; and doctorate degree.

^b Following Hirsch (2019), we assume the increased earnings also bring fringe benefits equal to 44.1% of earnings. These fringe benefits are not included in tax computations, and are assumed to grow at a rate of 0.041% per year. Fringe benefits have not been added to the increase in parental earnings.

^c Federal taxes on parental earnings are based on the overall average effective federal income tax rate (13.9%) because the raw data were not available to enable use of the income-specific rates. As a result, federal taxes on parents’ earnings are relatively high compared to taxes on participants’ earnings.

For a child in Michigan overall, these benefits are somewhat higher (\$111,490) due to the greater returns to educational attainment in Michigan overall, as indicated in the earnings data (USCB, 2014).

Finally, as described in the “State and local tax revenue” section above, the parents of ECE participants have also seen increased earnings as a result of their child’s participation in ECE (Masse & Barnett, 2002). We assume one-fifth of their assumed lifetime benefit (because their estimates were based on a 5-year program and we assume only one year of ECE participation), for a net lifetime benefit of \$18,189 per disadvantaged child in ECE in Detroit, and \$18,739 per child in Michigan overall (Figure 9).

Health

Children who participate in comprehensive early education programs are less likely to use tobacco or abuse drugs (Elango et al., 2015), resulting in a variety of health-related savings. The largest health-related savings associated with ECE come from reduced use of tobacco. About 19% of Michigan residents and 31% of Detroit residents smoke cigarettes on a regular basis (Murad & Daniel-Wayman, 2019; Whitmer et al., 2019). The mortality risk of daily tobacco use leads to a very high lifetime cost of the habit, estimated at \$1.4 million, but ECE programs have been shown to reduce the likelihood of daily tobacco use by 13% (Elango et al., 2015; Viscusi & Hersch, 2008). This results in a lifetime cost savings of almost \$22,000 per participant for Michigan overall, and a lifetime cost savings of almost \$35,000 per participant for Detroit (Figure 10).

ECE has also been shown to reduce the use of illicit drugs in adulthood, lowering the need for drug treatment, reducing the risk of premature death, and increasing lifetime earnings due to increased productivity. By reducing the probability of substance abuse by 22%, with an 8% rate of substance abuse disorder in Michigan, ECE saves about \$3,800 per participant in avoided drug treatment costs (Elango et al., 2015; Substance Abuse and Mental Health Services Administration [SAMHSA], 2019).¹²

Finally, ECE has been shown to reduce symptoms of depression by 33 percentage points, which we assume will reduce the costs of depression treatment by the same proportion (Carneiro & Ginja, 2014). Based on Greenberg et al. (2015), we estimate the per-person cost of depression to be \$13,159, assuming two years of treatment costs. ECE is thus expected to avoid depression treatment costs of \$2,426 per participant after discounting the future costs to their present value.

¹² We estimate the lifetime present value cost of drug abuse to be \$218,853, based largely on the lower-bound values presented in Table V of Cohen (1998); we only modify Cohen’s approach by updating the value of a statistical life to the one currently recommended by the United States Environmental Protection Agency (2018) and updating all figures to 2019 dollars.

10. Savings from improved health (per disadvantaged child in ECE)

	Detroit	Michigan
Reduced mortality from lower rates of daily tobacco use	\$34,883	\$21,901
Avoided costs of drug abuse	\$3,801	\$3,801
Avoided treatment costs for depression	\$2,426	\$2,426
Total savings	\$41,110	\$28,128

Sources: Carneiro & Ginja (2014); Cohen (1998); Elango et al. (2015); Greenberg et al. (2015); Murad & Daniel-Wayman (2019); SAMHSA (2019); Whitmer et al. (2019)

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs.

After accounting for the reduced mortality and avoided treatment costs associated with tobacco use, drug abuse, and depression, ECE-related savings total over \$41,000 per disadvantaged child in ECE in Detroit, and over \$28,000 per disadvantaged child in Michigan overall.

Summary of ECE benefits to individual participants and their families

The estimated potential individual benefits per disadvantaged child in ECE sum to over \$144,000 per child in Detroit and over \$158,000 per child in Michigan as a whole. This total includes between \$85,000 and \$111,000 in increased future earnings of the ECE participant (for Detroit and Michigan, respectively), about \$18,000 in increased earnings for the ECE participant's parent, and \$28,000-\$41,000 (for Michigan overall and Detroit, respectively) in savings due to improved health outcomes (Figure 11).

11. ECE benefits to individual participants and their families

	Detroit	Michigan
Total net lifetime earnings and fringe benefits: ECE participant	\$84,906	\$111,490
Improved health outcomes	\$41,110	\$28,128
Net increased parental earnings due to ECE	\$18,189	\$18,739
Total savings	\$144,206	\$158,357

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs.

Summary of total lifetime benefits of ECE for one disadvantaged child

The total lifetime benefit of ECE for one disadvantaged child is over \$200,000 in Detroit and in Michigan as a whole (Figure 12). Although the benefits to individuals make up 72-79% of those benefits (in Detroit and in Michigan overall, respectively), the public benefits still amount to at least \$42,000 (for one child in Michigan overall) and as much as \$57,000 (for one child in Detroit). Direct benefits to state and local government range from about \$16,000 in Michigan overall to over \$21,000 in Detroit, not including benefits to the K-12 system.

12. Estimated total lifetime value of school readiness (per disadvantaged child in ECE)

Cost savings category	Detroit	Michigan
K-12 savings	\$3,068	\$1,867
Savings and revenue to state and local government	\$21,318	\$15,870
Tax revenue to federal government	\$8,017	\$8,273
Public safety (avoided harm to victims of crime)	\$24,540	\$16,360
Individual benefits (to participants and their families)	\$144,206	\$158,357
Total potential lifetime savings per disadvantaged child	\$201,151	\$200,727

Notes: The estimated values of all future outcomes are discounted to their present value, using a 3% discount rate, from the age at which the outcome occurs.

Adjusting for effects of out-migration

Families moving out of Detroit and Michigan reduce the lifetime value of gaining school readiness in Detroit and Michigan. According to Bartik (2009), savings that accrue during childhood such as savings in school costs, child care subsidies, child welfare spending, and parental productivity are reduced by 9 percent, and other lifetime savings are reduced by about 28%. Accordingly, the total lifetime value of gaining school readiness for one disadvantaged child, adjusted for out-migration, is about \$139,522 in Detroit and about \$138,760 in Michigan as a whole.

Sensitivity analysis and additional estimations

We have used a discount rate of 3% for all estimates in this report, up to this point.¹³ However, because the majority of benefits associated with ECE materialize in the future, the discount rate used to account for the change in the value of these benefits as time passes can significantly affect the final values. Therefore, we perform a sensitivity analysis, computing the total benefits based on different discount rates to show how the benefits per child vary when future benefits are assigned more or less value. Total benefits range from a low of less than \$92,000 (Michigan overall, with 6% discount rate) to a high of \$530,000 (Michigan overall, with a 0.01% discount rate).

13. Sensitivity analysis: total benefits of ECE with various discount rates

Discount rate	0.01%	1%	2%	3%*	4%	5%	6%
Detroit	\$507,752	\$364,892	\$267,817	\$201,151	\$154,332	\$120,739	\$96,144
Michigan	\$530,187	\$375,677	\$271,524	\$200,727	\$151,608	\$116,842	\$91,757

*Rate used in the main analysis

Potential return on investment scenarios

The total per-child cost of Michigan early childhood education programs can vary between \$6,500 and \$13,500 per child per year (Barnett & Friedman-Krauss, 2016; MDE, 2019). If we combine these costs with the estimated benefits for Michigan overall, we find returns on investment in school readiness of about \$15 to \$30 per dollar invested. If we look only at the public return (excluding individual benefits to participants and their families), we find that the ROI ranges from \$3.13 to \$6.48 per dollar invested, with an average of \$5.40.

Note that benefits and costs per child vary across different ECE programs depending on local conditions. Thus, these returns should be interpreted with caution.

14. Potential return on investment – Michigan overall (per dollar invested)

ECE program	Assumed costs per child	ROI with total benefits	ROI with public benefits only
Michigan Great Start Readiness Program	\$6,542	\$30.68	\$6.48
Michigan Head Start	\$8,453	\$23.75	\$5.01
Michigan Early Head Start	\$13,516	\$14.85	\$3.13
Weighted average	\$7,850	\$25.57	\$5.40

Sources: Barnett & Friedman-Krauss (2016); MDE (2019)

¹³ WSIPP (2019) uses a rate of 3.5%, and a high rate of 5%. The Congressional Budget Office has used a 3% real discount rate in its analyses of Social Security. Most ECE studies used a 3% rate to summarize the main benefit-cost results. See <http://www.wsipp.wa.gov/TechnicalDocumentation/WSippBenefitCostTechnicalDocumentation.pdf> for details.

For Detroit, when we look at the ROI with all benefits included, we see similar values to the statewide ROI estimates, ranging from about \$15 to over \$30 per dollar invested. Because of the distribution of benefits in the Detroit estimates, Detroit yields some higher ROI values than the state overall when we look at public benefits only; those ROI values range from \$4.21 to \$8.70, with an average of \$7.25.

15. Potential return on investment – Detroit (per dollar invested)

ECE program	Assumed costs per child	ROI with total benefits	ROI with public benefits only
Michigan Great Start Readiness Program	\$6,542	\$30.75	\$8.70
Michigan Head Start	\$8,453	\$23.80	\$6.74
Michigan Early Head Start	\$13,516	\$14.88	\$4.21
Weighted average	\$7,850	\$25.62	\$7.25

Sources: Barnett & Friedman-Krauss (2016); MDE (2019)

Whether the value of ECE is examined from the perspective of the participant, the public overall, or the state and local government, it is clear that an investment in ECE yields a positive return on investment. The magnitude of that ROI may vary considerably, depending on the stakeholder of interest (participant, public, government) and on the choice of discount rate, but we see no reasonable scenario that offers any ROI of ECE less than \$2 per dollar invested. That is, based on the conservative estimate of benefits compiled in this report, for any investment in ECE, the absolute worst outcome that can be expected is to reap a benefit of twice the size of the investment. If we factor in the benefits to the general public and to the participants themselves, the ROI skyrockets to over \$25 per dollar invested. These results clearly indicate that investing in quality early childhood education makes economic sense.

The value of increasing ECE participation rates

To illustrate the potential value of increasing the rate of participation in ECE, suppose an additional 1% of 4-year-old children began participating in ECE. Given the current populations of 4-year-olds in Detroit (9,014 children) and Michigan overall (118,039 children),¹⁴ increasing the rate of ECE participation by one percentage point means an additional 90 children in Detroit and an additional 1,180 children in Michigan overall would begin participating in ECE. Given the estimated benefits of ECE as shown in Figure 12 above, paired with the average cost of ECE (\$7,850), the net benefits of this one-percentage-point increase in ECE participation add up to \$17.4 million in Detroit alone, and \$228 million in Michigan overall. The net public benefits of this increase in ECE participation (that is, excluding the benefits that accrue directly to the ECE participants and their families) add up to \$4.4 million in Detroit and \$41 million in Michigan overall.

¹⁴ United States Census Bureau, 2018b.

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Appendix

A1. Estimated lifetime savings per disadvantaged child in ECE (detail)

Cost category	Detroit	Michigan
K-12 special education	\$2,976	\$1,795
K-12 grade repetition	\$92	\$71
Subtotal K-12 lifetime savings	\$3,068	\$1,867
Legal system	\$11,469	\$7,646
State income tax revenue	\$3,751	\$4,515
Child care subsidies	\$3,263	\$3,078
Local income tax revenue	\$2,118	N/A
Public assistance	\$497	\$469
Child welfare	\$153	\$96
Unemployment insurance	\$67	\$67
Subtotal savings and revenue to state and local government	\$21,318	\$15,870
Federal income tax revenue	\$8,017	\$8,273
Avoided harm to victims of crime	\$24,540	\$16,360
Total public benefits per child in ECE	\$56,944	\$42,370
Increased net earnings for ECE participants in adulthood ^a	\$84,906	\$111,490
Reduced mortality from lower rates of daily tobacco use	\$34,883	\$21,901
Increased net earnings of child's parents ^a	\$18,189	\$18,739
Reduced substance abuse	\$3,801	\$3,801
Reduced symptoms of depression	\$2,426	\$2,426
Total individual benefits (to participants and their families)	\$144,206	\$158,357
Total per-child lifetime benefits	\$201,151	\$200,727
Total adjusted for out-migration	\$139,522	\$138,760

^a Estimated federal, state, and local taxes have been subtracted from the value of increased earnings to ensure that their value is only counted once.

A2. Early childhood education effect sizes (comparison of effect sizes used in 2015 and 2020 iterations of this report)

2020		2015	
Description	Effect size	Description	Effect size
High school graduation ²	20.7%	High school graduation ¹	9.3%
<i>Attended some college²</i>	13.6%	<i>Completed .5 credits at a 4-year college¹</i>	53.5%
<i>Number of felony arrests²</i>	-0.76	<i>Any felony arrest¹</i>	-27.0%
Any special education ²	-13.1%	Any special education ¹	-41.5%
Grade retention ²	-24.4%	Grade retention ¹	-40.1%
<i>Percentile score on depression scale, ages 16-17; we interpret this as a percentage reduction in average depression symptoms³</i>	-33.3%	<i>Any depression symptom¹</i>	-26.4%
<i>Self-reported drug user²</i>	-21.9%	<i>Substance misuse¹</i>	-23.9%
Daily tobacco use ²	-13.1%	Daily tobacco use ¹	-19.0%
<i>Ever on welfare (ages 18-27)²</i>	-14.0%	<i>Food Stamp receipt (ages 18-24)¹</i>	-9.3%
Any report of abuse or neglect from ages 4 to 7 ¹	-43.1%	Any report of abuse or neglect from ages 4 to 7 ¹	-43.1%
Any out-of-home placement ¹	-38.8%	Any out-of-home placement ¹	-38.8%

Sources:

1 Reynolds et al., 2011. Effect sizes are computed as the difference between rates of treatment and control groups, divided by the rate of the control group.

2 Elango et al., 2015

3 Carniero and Ginja, 2014

Notes: Italics indicate effect sizes for which the description differs between the effect size used in 2015 and the effect size used in 2020. All effect sizes are measured as the ECE-related percentage change in the outcome, relative to the base rate, with the exception of the number of felony arrests (2020 only). For more information, see the explanation of the computation of the cost savings in special education, in the body of the report.

A3. K-12 parameters and data

	Detroit	Michigan
Total K-12 expenditures (Includes transfers)	\$678,951,162	\$20,536,300,305
K-12 population	49,592	1,468,256
Expenditures per pupil	\$13,691	\$13,987
Expenditures per pupil (inflation-adjusted)	\$13,958	\$14,259
Number of students retained	1,860	41,653
Percentage of students retained	3.8%	2.8%
Graduation rate	77%	81%
Students in special education with conditions assumed to be affected by ECE ^a	7,814	198,096
Autism Spectrum Disorder	946	20,595
Cognitive Impairment	1,575	18,847
Early Childhood Developmental Delay	383	7,461
Emotional Impairment	336	11,333
Specific Learning Disability	2,284	59,645
Speech & Language Impairment	1,481	52,768
Other Health Impairment	809	27,447
Students with excluded conditions (assumed to be minimally affected by ECE)	575	9,245
All students in special education	8,389	207,341
Percentage of students in special education with conditions assumed to be affected by ECE	16%	13%
Total special education expenditures (labeled in source as “added needs programs”)	\$119,195,770	\$2,075,318,575
Annual special education expenditure per student	\$14,209	\$10,009
Annual special education expenditure per student (inflation-adjusted)	\$14,485	\$10,204
Assumed number of years of special education	12	12

Sources: Center for Performance and Education, Michigan Department of Education. MI school data. Retrieved from: <https://www.mischooldata.org/DistrictSchoolProfiles2/StudentInformation/StudentSummary.aspx>; Michigan Department of Education. (2019). 2017-18 Bulletin 1011- Analysis of Michigan Public School Districts Revenues and Expenditures. Retrieved from https://mdoe.state.mi.us/SAMSPublic/others/b1011_18%20FINAL.pdf

Note. K-12 parameters are based on 2017-18 data unless indicated otherwise. Monetary values in this figure are in 2018 U.S. dollars unless the label indicates that it is inflation-adjusted. Inflation-adjusted values are in 2019 U.S. dollars.

^a To be conservative, the base rate for incidence of special education does not include students whose conditions are unlikely to benefit from ECE. The following conditions were excluded in the computation of the base rate: Deaf-blindness, hearing impairment, physical impairment, severe multiple impairment, traumatic brain injury, and visual impairment.

A4. Victim costs associated with crime (selected felonies)¹⁵

Costs	Average for any felony	Felony sex crimes	Robbery	Aggravated assault	Felony property
Victim costs (tangible)	\$6,618	\$6,008	\$3,567	\$9,408	\$2,078
Victim costs (intangible)	\$32,185	\$214,341	\$5,381	\$14,528	-
Count of felony cases per 100,000 people in Michigan, 2018		2,241	1,194	10,999	5,655
Percentage of felony cases in Michigan, 2018		11%	6%	55%	28%
Weighted average total victim cost per felony	\$38,803	-	-	-	-

Sources: Victim costs from Schlueter (2014), adjusted for inflation. Arrest counts from Michigan State Police (2018).

Notes: Arrest counts are based on data from Michigan State Police (2018). Offenses were grouped by authors to align with the crime categories for which victim's cost estimates were available.

A5. Effective income tax rates (federal, based on tax year 2014)

Income range	Effective income tax rate
\$1 - \$24,999	1.7%
\$25,000 - \$49,999	5.2%
\$50,000 - \$99,999	8.7%
\$100,000 - \$199,999	12.6%
\$200,000 - \$499,999	19.5%
\$500,000 - \$999,999	25.8%
\$1,000,000 - \$9,999,999	29.0%
>\$10,000,000	26.1%
Overall average	13.9%

Source: Frankel (2016)

¹⁵ ECE would likely reduce the incidence of several other types of felonies (arson, murder) as well, but data on victims' costs were unavailable for these other felonies.

A6. Rate of growth of earnings

All	0.0137
Less than high school	-0.0062
High school	0.0053
Some college	0.0095
College	0.0115
Ratio of benefits to wages and salaries	1.441
Growth rate of benefits	0.00041

Source: Hirsch, 2019

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