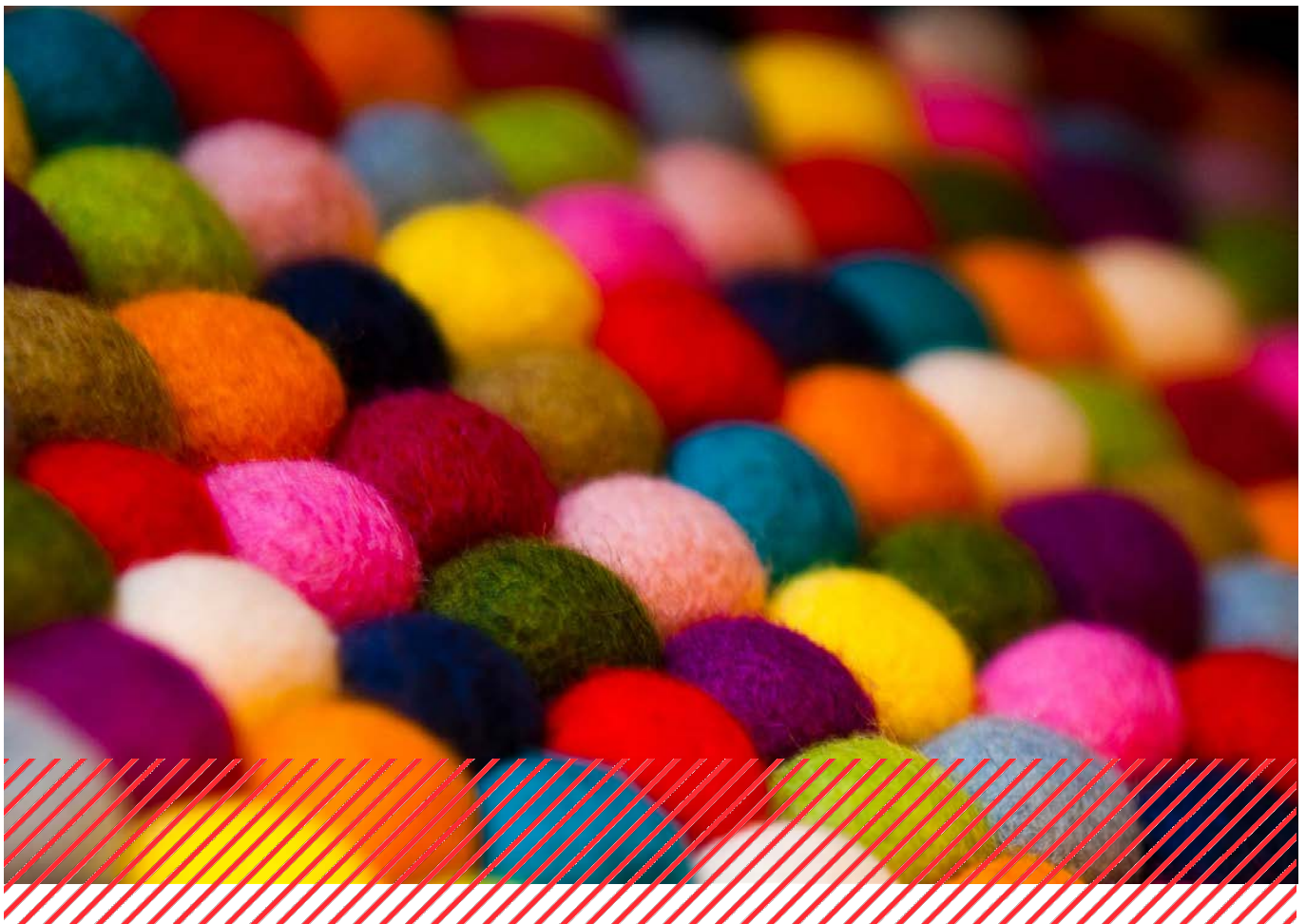


# Cost-Benefit Analyses of Early Childhood Interventions

A Methodological Review of Studies Published in 2008-2017



Louise Beuchert and Mette Verner

*Cost-Benefit Analyses of Early Childhood Interventions – A  
Methodological Review of Studies Published in 2008-2017*

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*Hans Hummelgaard*

Head of Research, VIVE Quantitative Methods  
2019

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# Summary

This report is based on a systematic literature search completed in December 2017.

The aim of this report is to provide a review of how cost-benefit analyses of early childhood programmes are conducted. We take as our point of departure an earlier review by Karoly and coworkers at RAND, who reviewed the literature in 2008 and discussed the potential for a more standardised framework in future cost-benefit analyses (Karoly 2008). We extend this work by reviewing cost-benefit analyses published after 2008. We describe the general framework and summarise the latest methodological developments. The goal is to determine whether the field has attained more standardisation regarding how cost-benefit analyses of early childhood programmes are carried out, and the review can serve as a guide when conducting cost-benefit analyses in the future.

The report is structured in eight chapters.

Chapters 1 and 2 introduce the reader to cost-benefit analyses; Chapter 1 describes the background and objective of the report, and Chapter 2 briefly describes the general framework of cost-benefit analyses applied in the field of early childhood programmes.

Chapter 3 describes the systematic literature search that comprises the data source of this review. The aim of the systematic literature search is to find cost-benefit analyses from the past decade to review and discuss the latest methodological developments.

Chapter 4 describes collection and estimation of the programme's costs. The standards for cost estimations are fairly established in the literature (see e.g. work by Levin and McEwan). However, the literature synthesis revealed that many intended cost-benefit analyses failed due to a lack of (reliable) cost data. Due to this flaw, studies then failed to report cost-benefit ratios and only provide brief, if any, back-of-the envelope calculations based on, for instance, annual state expenses on preschool. In this chapter, we summarise the cost collection methods applied in the reviewed cost-benefit analyses.

Chapters 5-7 review identification and estimation of the programme's benefits. Chapter 5 describes the general framework for assessment of benefits from early childhood followed by a review of benefits included in the past decade's cost-benefit analyses identified in our literature search. Chapter 6 discusses estimation of childhood benefits in the areas cognitive, socio-emotional/behavioural development, education and child maltreatment. Chapter 7 discusses estimation and projection of future outcomes in the domains of earnings and employment, health, crime and social services.

Chapter 8 discusses some of the general methodological issues in cost-benefit analyses of early childhood programmes (such as uncertainty and determining which benefits should be monetised) and reviews the approaches applied in the cost-benefit analyses.

Each chapter can be read independently, and each chapter summarises methodological issues and provides the reader with examples from the reviewed cost-benefit analyses. In addition, each chapter provides tables reporting the applied methods and includes references for further reading (e.g. applied methods for standard errors and uncertainty). Thus, the report can serve as a (reference) catalogue for specific methodological issues.

Our main findings can be summarised as follows:

We find that for programme cost collection and calculation well-established methods exist, and that there is a consensus in the literature that the “ingredient method” is recommended. However, this method appears to be difficult to implement in practice, and in the majority of the reviewed studies the costs are estimated retrospectively.

In the case of benefit calculation, methods are less established. Monetisation and inclusion of children’s cognitive, behavioural and emotional development is rarely performed, and a main reason for this is that shadow prices for these domains are less developed/do not exist. A large share of the studies include observed or projected adult outcomes. A substantial number of the benefits are actually cost-savings, as improved outcomes in health and crime, for instance, tend to decrease costs in these domains. We find that the later studies tend to include projections in several domains and that there is an increase in the use of microdata from various sources.

We conclude that the field is (still) characterised by lack of standardisation regarding which benefits to include in cost-benefit analyses and how these are to be monetised. This is largely due to a lack of data and the fact that it is not possible to assign monetary values on important outcomes of early childhood programmes. This means that the availability of data will often determine which benefits it is possible to include and define shadow prices. Furthermore, complete cost-benefit analyses to a great extent rely on projections of future benefits. Projection methods are still developing – and again the data availability is crucial for the quality of projections.

Finally, we recommend continuing the work to collect systematic data and evidence to build and obtain better shadow prices for early childhood outcomes and thereby improve cost-benefit analyses of early childhood programmes.

# Dansk sammenfatning

Cost-benefit-analyser (CBA) beskriver den monetære værdi af gevinster (benefits) ved en indsats i forhold til indsatsens omkostninger (costs). Der er en stadigt voksende interesse for cost-benefit-analyser, fx blandt beslutningstagere, som skal vælge mellem forskellige indsatser, der har til formål at forbedre børns kompetencer og fremtidige livsvilkår.

Rapporten kortlægger metoder anvendt i cost-benefit-analyser af tidlige indsatser på børneområdet (early childhood programs). Eksempler på tidlige indsatser er indsatser i dagtilbud, sundhedsplejen, førskoleprogrammer og forældretræningsprogrammer, der iværksættes, inden barnet når skolealderen.

## Grundlag for rapporten

Denne rapport er inspireret af en tidligere kortlægning af cost-benefit-metoder af sociale programmer fra Karoly (2008), der konkluderede, at der manglede veletablerede metoder til gennemførelse af cost-benefit-analyser. Karoly (2008) pointerede, at der især mangler metoder til inddragelse af værdien af børns sociale og trivselsmæssige udvikling fra deltagelse i tidlige indsatser, og at der manglede fælles standarder for metoderne anvendt i cost-benefit-analyser. Formålet med denne rapport er derfor at opdatere Karoly (2008) med den seneste metodiske udvikling baseret på nyeste cost-benefit-analyser udgivet gennem de seneste 10 år. Metodegennemgangen bygger på en systematisk litteratursøgning på cost-benefit-analyser af tidlige indsatser, som er udgivet i perioden 2008-2017. Litteratursøgningen resulterede i 15 komplette cost-benefit-analyser af tidlige indsatser på børneområdet. Rapporten er herefter baseret på en grundig gennemgang af metoder anvendt i disse studier.

Følgende forskningsspørgsmål har været udgangspunktet for kortlægningen:

*På grundlag af de identificerede cost-benefit-analyser offentliggjort i perioden 2008-2017 at undersøge:*

1. Hvilke metodemæssige skridt er der taget for at udvide standard cost-benefit-analyser til cost-benefit-analyser for tidlige indsatser på børneområdet?
2. Hvordan omregnes kortsigtede effekter af tidlige indsatser til værdi i kroner? Effekter af tidlige indsatser er typisk målt som forbedringer i barnets sociale udvikling, sproglige udvikling eller skolegang. Denne type mål har dog hverken en naturlig pengeværdi eller markedsværdi, og det er derfor en udfordring at opgøre denne type gevinster i kroner, så de kan medregnes i den samlede cost-benefit-analyse.
3. Hvordan estimeres og omregnes de forventede langsigtede effekter af tidlige indsatser til værdi i kroner, når de langsigtede effekter endnu ikke kan observeres? Langsigtede effekter af tidlige indsatser kan for eksempel være økonomiske gevinster (livstidsindkomst), mindre kriminalitet, mindre misbrug af rusmidler og forbedret sundhed.



Rapportens formål er ikke at opsummere den samlede evidens om effekten af tidlige indsatser – her henvises i stedet til metaanalyser på området. Rapportens fokus er på metoder til udarbejdelse af cost-benefit-analyser og udviklingen i disse.

## Rapportens hovedresultater

Herunder følger rapportens hovedkonklusion for hvert af de tre forskningsspørgsmål efterfulgt af andre centrale overvejelser ved udarbejdning af cost-benefit-analyser.

### **(1) Hvilke metodefremskridt er der taget for at udvide standard cost-benefit-analyser til cost-benefit-analyser for tidlige indsatser (indsatser på børneområdet).**

#### **Metoder til opgørelse af omkostninger**

Kortlægningen viser, at der findes veletablerede og anbefalede metoder til at indsamle en indsats' omkostninger, som kan overføres til tidlige indsatser på børneområdet, for eksempel fra Levin og McEwan (2002, 2012, 2018) eller Belfield et al. (2015) om beregning af omkostninger for skoleindsatser og sociale indsatser. Det anbefales generelt at anvende ingredientmetoden, hvormed hver "ingredient" (element) i en indsats og tilhørende enhedspriser tydeligt specificeres. Elementer er for eksempel dagtilbuddets forbrug af materialer, personale og efteruddannelse. Ingredientmetoden øger gennemsigtigheden af de omkostninger, der indgår i cost-benefit-beregningen og tillader følsomhedstest, hvor det er muligt at justere på antagelser om for eksempel enhedspriser eller forventet tidsforbrug.

Kortlægningen viser dog, at ingredientmetoden, særligt for indsatser, der er afprøvet for mange år siden, ikke er anvendt i praksis. Det skyldes, at det er ressourcekrævende at registrere og indsamle data om omkostninger til implementering, materialer, lønninger osv., mens indsatsen kører, og det har typisk heller ikke været en del af indsatsen, at der skulle foretages en opfølgende evaluering. En række af de kortlagte studier anvender derfor historiske kilder (for eksempel gamle projektbeskrivelser, budgetter eller nationale statistikker om dagtilbud) til at beregne, hvad man forventer, at indsatsen dengang har kostet.

For igangværende eller nye indsatser anbefales det, at der indsamles data om indsatsens elementer og priser fra indsatsens start og løbende under implementeringen, da det vil danne grundlag for en mere retvisende omkostningsberegning, end hvis disse informationer først skal indsamles, efter indsatsen er afsluttet.

#### **Metoder til opgørelse af gevinster**

Der findes ligeledes veletablerede metoder til at estimere de primære effekter af en tidlig indsats (se litteratur om effektevalueringer), men omregningen af indsatsens primære effekt (for eksempel "styrke børns sociale udvikling") til en monetær værdi i kroner er mindre veletableret.

Rapporten kortlægger metodefremskridt inden for følgende domæner for potentielle gevinster af tidlige indsatser:

**Tabel 1** Domæner for potentielle gevinster af tidlige indsatser

Potentielle effekter målt i barndommen:	Potentielle forventede effekter som voksen:
Kognitiv udvikling	Arbejdsmarked
Social- og adfærdsmæssig udvikling	Sundhed
Skolegang og uddannelse	Kriminalitet
Sociale indsatser	Sociale indsatser

Vi kortlægger de 15 studier i forhold til inddragelsen af de otte domæner, men efter nærlæsning er der kun få studier, der reelt værdiansætter gevinster fra et eller flere af disse domæner. Den lave andel af studier publiceret i perioden 2008-2017, der inkluderer disse domæner, tydeliggør, at der endnu ikke er etableret et standardiseret framework for, hvilke gevinster der bør inkluderes i cost-benefit-analyser af tidlige indsatser. Dette skyldes i høj grad mangel på data og manglende muligheder for at værdiansætte centrale udfaldsmål for tidlige indsatser.

Selve værdiansættelsen af gevinster, hvor udfaldsmålet har en markedsværdi og derfor naturligt kan omregnes til kroner, foretages ved at omregne de primære effekter til kroner ved at beregne den tilsvarende forbedring i forventet livstidsindkomst. Eksempler på dette er værdien af bedre chancer for at gennemføre en uddannelse eller komme i arbejde,

For andre "bløde" gevinster, såsom effekter på børns kognitive udvikling, sociale udvikling, sundhed eller kriminalitet, anvendes skyggepriser. En skyggepris er en værdi i kroner, der afspejler den værdi, samfundet tillægger den pågældende gevinst (fx styrket social udvikling). For at få den fulde skyggepris medregnes også den værdi, som individet selv tillægger den pågældende gevinst. Inddragelse og værdiansættelse af børns kognitive, sociale og adfærdsmæssige kompetencer i cost-benefit-analyser foretages relativt sjældent, hovedsagelig pga. manglende skyggepriser for disse domæner. Der er dog større tendens til inddragelse af flere domæner i de senere studier.

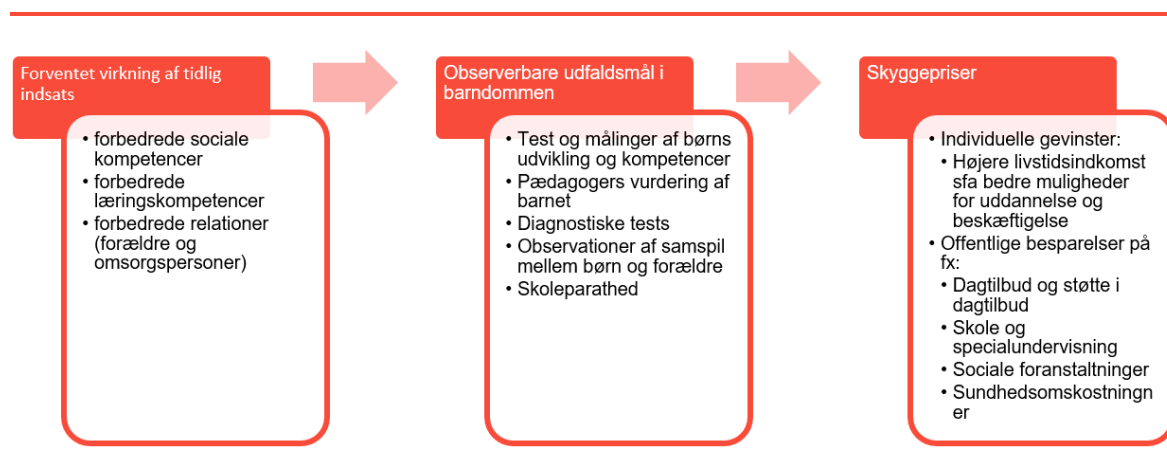
**(2) Hvordan omregnes kortsigtede effekter af tidlige indsatser til værdi i kroner? Effekter af tidlige indsatser er typisk målt som forbedringer i barnets sociale udvikling, sproglige udvikling eller skolegang. Denne type mål har dog hverken en naturlig pengeværdi eller markedsværdi, og det er derfor en udfordring at opgøre denne type gevinster i kroner, så de kan medregnes i den samlede cost-benefit-analyse.**

Kortsigtede gevinster beregnes typisk ved anvendelse af observerbare data om børnenes udvikling målt kort efter en indsats. Først laves en effektmåling for at estimere indsatsens primære effekt på deltagerne. Derefter omregnes de estimerede primære effekter til værdi i kroner. For at omregne disse effekter til værdi i kroner anvendes typisk skyggepriser.

For samfundet er skyggeprisen typisk opgjort som værdien af de forventede besparelser på offentlige udgifter (cost-savings), der kan tilskrives de estimerede effekter af den tidlige indsats. Dette kan beregnes ved hjælp af data om forbrug af offentlige ydelser. Men det kræver også viden om sammenhængen mellem de "bløde værdier" (fx børns sociale udvikling) og senere forbrug af offentlige ydelser (fx skole og sociale ydelser) for at kunne omregne en given forbedring (effekt) i den bløde værdi til, hvor stor reduktion i forbrug af offentlige ydelser den forbedring vil medføre. Denne viden er begrænset – også i den internationale litteratur – da den kræver både en lang tidshorizont (børn skal følges, fra de er børn til voksen) og systematisk data på individniveau (fx nationale målinger af børns udvikling og senere outcomes).

For individet er skyggeprisen typisk afspejlet ved den forventede forbedring i livstidsindkomst ved en forbedring af de bløde mål i barndommen. Dette kommer af, at der er en stor litteratur, der har fokuseret på at undersøge afkastet af uddannelse, hvor afkastet typisk måles som livstidsindkomst, og dermed findes en monetær værdi. Der mangler dog fortsat gode bud på, hvordan de kortsigtede effekter for individet af tidlige indsatser omdannes til en monetær værdi, således at de kan medregnes i cost-benefit-analyser.

**Figur 1** Illustration af skyggepriser for børns udfaldsmål



Note: Figuren viser eksempler på potentielle gevinster, udfaldsmål og skyggepriser. Listen er ikke udtømmende.

Kortlægningen viser, at kun to studier omregner de fundne effekter på børns sociale og emotionelle udvikling til kroner, skønt mange studier diskuterer og redegør for vigtigheden af at inkludere disse gevinster i cost-benefit-analysen. Kortlægningen finder fire studier, der omregner kognitive effekter til kroner, og syv studier omregner forskellige gevinster på børns skolegange og uddannelse til kroner.

De mest veletablerede skyggepriser, der findes, er for forbedring af børns læring og faglige niveau. Her anvender man resultaterne fra studier, der viser den statistiske sammenhæng mellem børns testresultater og senere uddannelse og indkomst. En forbedring af barnets testresultater kan således omregnes til kroner gennem reducerede offentlige udgifter til skolesystemet (gennem mindre behov for specialundervisning mv.) og private fordringer i livstidsindkomst (gennem højere uddannelsesniveau). Sådanne estimater eksisterer også for danske børn og kan anvendes i cost-benefit-analyser af tidlige indsatser i Danmark (fx Kristoffersen og Smith (2013) om SDQ mål; Beuchert og Nandrup (2018) om testresultater). Men for en lang række af andre bløde mål (fx trivsel, personlig udvikling og mere stabile familieforhold) vil det være nødvendigt at undersøge disse sammenhænge, før der kan foreslås skyggepriser, og de kan medregnes i cost-benefit-analyser.

De nævnte studier ovenfor viser statistiske korrelationer mellem diverse børnemålinger og senere outcomes som voksen. En anden tilgang er at frembringe estimater for det offentlige forbrug (besparelser) på specifikke målgrupper, såfremt disse målgrupper oplever en effekt af en indsats. Et eksempel herpå er den socialøkonomiske investeringsmodel (SØM), som indeholder databaser med udvalgte målgruppers forbrug af offentlige ydelser, enhedspriser for de offentlige ydelser og estimater på sammenhængen mellem en målgruppe og dennes fremtidige offentlige forbrug. Modellen er en budget-økonomisk model, der viser kort- og langsigtede gevinster for de offentlige budgetter, men ikke medtager deltagerens private gevinster. Modellen er udviklet med henblik på specifikke målgrupper af socialt udsatte, og det er på forhånd bestemt, hvad en "effekt" af en indsats

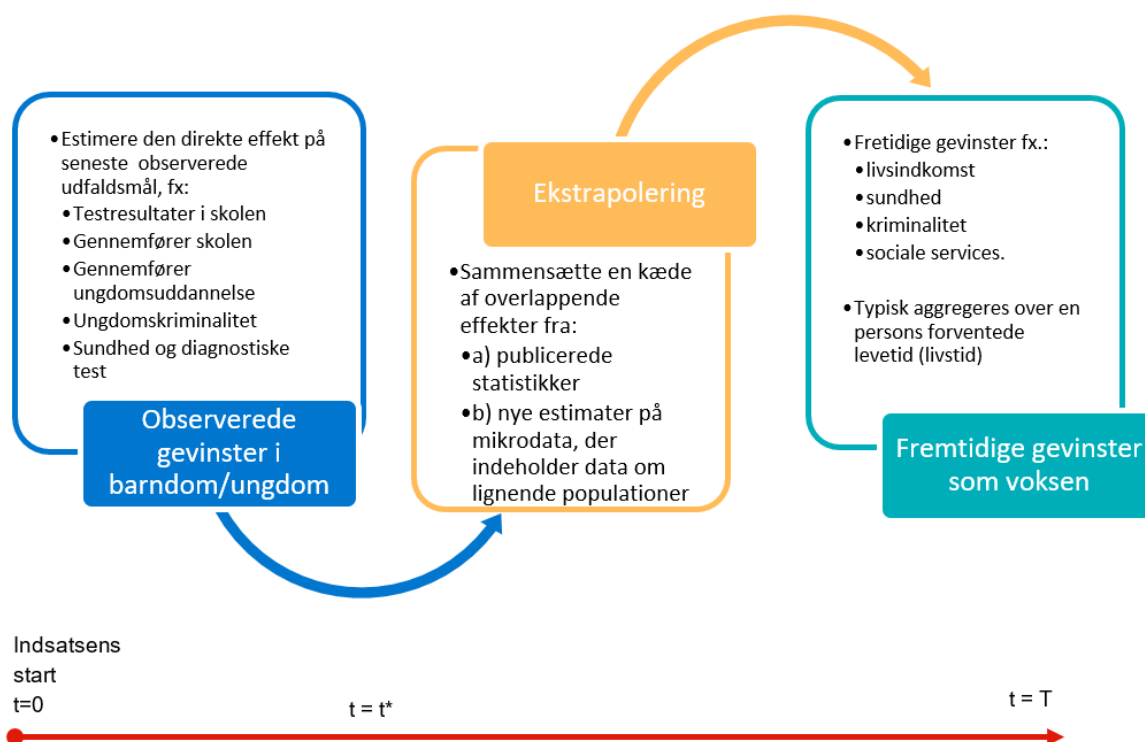
er (kaldet succes mål i SØM). De skyggepriser, der er i databasen, er derfor estimater alene for den pågældende målgruppe og effektmål.

**(3) Hvordan estimeres og omregnes de forventede langsigtede effekter af tidlige indsatser til værdi i kroner, når de langsigtede effekter endnu ikke kan observeres? Langsigtede effekter af tidlige indsatser kan for eksempel være økonomiske gevinster (livstidsindkomst), mindre kriminalitet, mindre misbrug af rusmidler og forbedret sundhed.**

Rapporten viser at, det er centralt, at værdien af de (forventede) langsigtede effekter af indsatser medregnes i cost-benefit-analyser. Oftest vil disse være uobserverede på det tidspunkt, analysen udarbejdes, og derfor er der brug for at prædikere de langsigtede effekter. Kortlægning har afdækket metodefremskridt inden for domænerne arbejdsmarked, sundhed, kriminalitet og socialområdet som voksen.

Kortlægningen viser, at der i en række studier inddrages langsigtede gevinster for flere domæner. I de simpleste studier begrænses den langsigtede gevinst til at være i form af øget livsindkomst, men ofte vil bedre sundhed, mindre kriminalitet o.l. også bidrage til gevinsterne. Disse gevinster vil både kunne være private og samfundsmæssige gevinster. Det vil kunne forbedre cost-benefit-analyserne yderligere, hvis viden fra flere forskningsfelter inddrages, når gevinsterne beregnes – fx fra sundhedsvidenskab, kriminologi o.l.

**Figur 2** Illustration af ekstrapolering fra observerede udfaldsmål i barndommen/ungdommen til fremtidige gevinster som voksen



Note: Figuren illustrerer metoden ekstrapolering, og hvordan man kommer fra observerede gevinster i barndommen til fremtidige gevinster som voksen. Tidslinjen illustrerer en persons levetid i år ( $t$ ) fra indsatsens start ( $t=0$ ) til år  $t=T$ .  $t^*$  er det seneste observerede data om personen, fx  $t=5$ , hvis det er muligt at observere personen fem år efter indsatsens start. Efter år  $t^*$  anvendes overlappende links for at prædikere personens fremtidige udfaldsmål frem til år  $t=T$ .

De forventede langsigtede effekter beregnes generelt ved at lave en kæde af forventede afledte/overlappende effekter fra den observerede kortsigtede effekt til effekter på mellemliggende perioder i personen liv og derfra til det lange sigte. Dette kaldes for ekstrapolering og er illustreret i ovenstående figur.

Kortlægningen viser, at der, til selve ekstrapoleringen, generelt anvendes to forskellige tilgange.

Den mest udbredte tilgang er at benytte aggregerede nationale statistikker og/eller estimater fra andre studier til at prædiktere de forventede langsigtede effekter. Ved brug af estimater fra andre studier kan der sammensættes en kæde af forventede effekter til et "overlappende forløb". Et eksempel på sådanne "overlappende forløb" er: Fra et studie kender man effekten af en forebyggende indsats i daginstitutioner for de faglige resultater i indskolingen, fra et andet studie kendes sammenhængen mellem faglige resultater i skolen og sandsynligheden for gennemførelse af en ungdomsuddannelse, og til sidst, det tredje led i kæden, viser et studie sammenhængen mellem gennemførelse af ungdomsuddannelse og livsindkomster. Ved hjælp af disse estimater kan det således forudsiges, hvilke effekter der kan forventes at være af indsatsen for den fremtidige indkomst.

De nyere mere avancerede studier har benyttet eksisterende mikrodatasæt, fx administrative registerdata, til at konstruere en "syntetisk" population, der er en sammenlignelig gruppe af børn fra tidligere årgange end studiepopulationen. Fordelen herved er, at disse årgange kan følges over en længere årrække i data. Ud fra den syntetiske population er der beregnet de forventede gevinster af indsatsen i form af fx øget livsindkomst, mindre kriminalitet, lavere forbrug af sociale services og bedre sundhed. Fordelen ved at benytte denne tilgang er, at der kan tages højde for både observerede og uobserverede karakteristika. En potentiel svaghed ved at benytte denne tilgang til beregning af de forventede langsigtede effekter er, at den syntetiske population skal være repræsentativ for studiepopulationen, for at deres effekter kan overføres til den nuværende studiepopulation. Desuden forudsættes det, at resultaterne kan overføres mellem tidsperioder. Ud fra kortlægningen vurderes det, at brugen af mikrodata til beregning af de langsigtede effekter danner grundlag for bedre estimater for de langsigtede effekter end fx brug af historiske, aggregerede statistikker.

I den danske/skandinaviske kontekst er der gode registerdata til rådighed, som dækker mange domæner og ofte for en lang årrække. Derfor er der gode muligheder for at benytte metoden med konstruktion af en syntetisk population til at estimere de langsigtede effekter. Det skal dog bemærkes, at registerdata i sig selv ikke sikrer, at de estimater, der kan findes for sammenhængen mellem faktorer i barndom og som voksen, er kausale – dertil skal anvendes naturlige eller sociale eksperimenter.

## Andre overvejelser og metodefremskridt

### **Inkluderede effekter /domæner**

Det kræver nøje overvejelse at afgøre, hvilke effekter der bør inkluderes og værdifastsættes som gevinster i cost-benefit-analyser inden for forskellige domæner. Udgangspunktet for disse overvejelser kan være både teori og kausale effektestimater. Desuden bør det overvejes, om der er risiko for, at samme effekt tælles med to gange, og om det evt. bør antages, at en effekt ændrer sig over tid.

For nogle indsatser (fx "HighScope Perry Preschool Program") er der lavet gentagne cost-benefit-analyser, efterhånden som tiden er gået, og der er inkluderet flere faktisk realiserede udfald i de senere analyser. Dermed er det muligt at sammenligne de tidligere prædiktioner for gevinster med de faktiske udfald. Det viser sig oftest, at der faktisk realiseres større gevinster, end der tidligere

blev prædikeret. Dette indikerer bl.a., at der bør prædikeres gevinster for flere domæner i cost-benefit-analyserne, og at effekterne kan være mere langsigtede end antaget i modellen for prædication.

### **Inklusion af effekter for familiemedlemmer (afsmitning/spillover)**

En tidlig indsats kan have effekter for andre familiemedlemmer end det barn, som indsatsen primært er målrettet. Det vil fx være tilfældet, hvis forældrene øger arbejdsudbuddet, når der er brug for mindre børnepasning i hjemmet, eller hvis der er afsmitning på søskendes udvikling. Disse indirekte "smitteeffekter" kan således værdisættes og medregnes i gevinsten af indsatsen på samme måde som de direkte effekter. Disse effekter kan være både positive og negative.

Spillover-effekter (smitteeffekter) for familiemedlemmer kan inkluderes og værdisættes på samme måde, som man gør for det barn, der modtager indsatsen: Først identificeres de potentielle gevinster af indsatsen ved hjælp af teori eller kausale modeller. Dernæst estimeres effekterne af indsatsen for familiemedlemmernes observerede udfaldsmål, som de er målt efter indsatsen, og derefter værdisættes effekterne ved brug af samme tilgang (fx ved hjælp af skyggepriser) som den, der benyttes for det deltagende barn. Vi anbefaler, at der foretages de samme følsomhedsanalyser for gevinsterne fra spillovers som for de øvrige gevinster.

Kortlægningen fandt tre studier, der inkluderer spillover-effekter på forældres arbejdsudbud, og et studie, der inkluderer effekter på tidligere anbragte børns egne børn. Kortlægningen har ikke identificeret studier, der inkluderer potentielle udfaldsmål for søskende eller egne børn, som ikke er observerbare i data.

### **Følsomhedsanalyse og usikkerhed**

Beregning og estimation af gevinster er følsom over for, hvilke modelspecifikationer der benyttes, og hvilke antagelser der gøres. Derfor er det vigtigt at udføre og afrapportere følsomhedsanalyser, hvor der benyttes forskellige antagelser. Eksempler på dette er forskellige diskonteringsrater, forskellige metoder til prædication af livtidsindkomster eller inddragelse/udeladelse af forskellige domæner af gevinster.

Derudover er det centralt, at der beregnes og rapporteres usikkerhed på estimater for omkostninger og gevinster samt for den endelige cost-benefit-ratio, idet både effektestimater og prædicationer er behæftet med usikkerhed. Karoly (2008) fandt, at meget få cost-benefit-studier afrapporterede standardfejl for cost-benefit-ratioen, mens vi i dette studie finder, at omkring halvdelen af studierne viser standardfejl for cost-benefit-ratioen.

### **Afrapportering af cost-benefit-analyser**

Ved udførelsen af kortlægningen er det tydeligt, at der er stor variation i, hvordan resultater af cost-benefit-analyser rapporteres. Eftersom resultaterne er følsomme over for metodiske valg og antagelser, ligesom der ikke er konsensus i litteraturen om, hvilke domæner der indgår i beregningen af gevinsterne, er det vigtigt, at der er transparens i afrapporteringen vedrørende metodiske valg og antagelser. I boks 1 ses vores anbefaling af, hvad der som minimum bør fremgå af afrapporteringen af cost-benefit-analyser.

#### Boks 1. Af afrapportering af cost-benefit-analyser bør fremgå:

- Metoden anvendt til effektmåling
- Information om indsatsen (for eksempel målgruppe, programindhold, tidsperiode)
- Gennemsigthed omkring metoder anvendt til at beregne omkostninger og gevinster
- Gennemsigthed omkring beregning af cost-benefit-ratio
- Diskonteringsrate og hvilket år eller alder på børnene, der diskonteres til.
- Usikkerhed og standardfejl
- Følsomhedsanalyse
- Opgørelse af omkostninger og gevinster på et disaggregeret niveau.

## Anbefalinger til udarbejdelse og afrapportering af cost-benefit-analyser af tidlige indsatser

De følgende anbefalinger er udarbejdet på baggrund af kortlægningen. Anbefalingerne skal understøtte en større grad af systematik og gennemsigthed i udarbejdelsen af cost-benefit-analyser. På sigt vil en større grad af gennemsigthed styrke muligheden for at sammenligne resultater på tværs af cost-benefit-analyser på børneområdet og derved danne et bedre grundlag for beslutningstagere, der skal vælge mellem en eller flere programmer på børneområdet.

Anbefalingerne er målrettet cost-benefit-analyser af tidlige indsatser på børneområdet, men kan overføres til social indsats generelt.

### OMKOSTNINGER (COSTS)

- **Omkostninger bør afspejle de marginale omkostninger**

Programmets omkostninger opgøres som de ekstra omkostninger (marginale omkostninger), der er ved at implementere og drifte dette program sammenlignet med et andet program eller business-as-usual.

For eksempel opgøres omkostningerne til en læsetræningsindsats i børnehaven som de ekstra omkostninger, der er til denne specifikke indsats (bøger, materialer, efteruddannelse til pædagoger), udover hvad der afsættes til normal drift af børnehaven.

Omkostninger i form af forventede besparelser på offentligt forbrug (for eksempel færre børn med læsevanskeligheder i skolen) medregnes ikke som en del af programmets omkostninger (det medregnes i stedet under programmets gevinster).

- **Omkostninger bør indeholde alternativomkostninger**

Programmets omkostninger bør også indeholde deltageres alternativomkostninger. For eksempel en opgøres af, hvad det koster for pædagoger og forældre at anvende sin tid på dette program – tid, der ellers kunne være brugt på noget andet.

For eksemplet med en læsetræningsindsats kan alternativomkostningen af, at pædagogen skal på kursus for at varetage programmet, opgøres som omkostninger til vikarer og forældres omkostning ved at bruge ekstra tid på læsetræne hjemme fremfor at bruge tid på arbejde, husligt arbejde eller fritid.

- **Anvend "ingredientmetoden" til indsamling af omkostninger**

Det anbefales, at indsatsens omkostninger indsamles løbende under implementeringen af indsatsen. For at sikre, at gennemsigthed og alle elementer medregnes, anbefales det at anvende "ingredientmetoden", hvor man specificerer hvert element og den tilhørende enhedspris, der anvendes i indsatsen.

- **Afrapportér de samlede omkostninger og opgjort for hvert omkostningsdomæne**

Det anbefales, at de samlede omkostninger afrapporteres sammen med en opgørelse på hver kategori af omkostninger (for eksempel opgjort på administration, materialer og efteruddannelse af personale). Derved sikres gennemsigthed i omkostningsberegninger, og det er muligt at sammenligne, hvilke omkostninger der er gældende på tværs af programmer. Samtidig bør omkostningsestimaterne vedlægges en beskrivelse af væsentlige antagelser, der kan have betydning for den samlede omkostningsberegning, herunder afrapportering af alternativomkostningsestimater, hvor disse antagelser justeres (for eksempel ved at afrapportere et nedre og et øvre estimat for omkostningen).

## GEVINSTER (BENEFITS)

- **Benefits bør inkludere både private og offentlige gevinster**

For en komplet beregning af gevinsterne ved en indsats bør de private gevinster medtages, der tilfalder den enkelte deltager i programmet (barnet), de offentlige gevinster, der tilfalder den offentlige sektor (og dermed skatteyderne), samt gevinster, der tilfalder samfundet som helhed (de sidstnævnte kan både være private og offentlige).<sup>1</sup> Gevinster ved en indsats kan være både positive og negative.

- **Redegør for, hvilke gevinster der medtages og ikke medtages**

Ideelt set medregnes alle relevante gevinster, men det er ofte ikke muligt grundet databegrænsninger. Derfor anbefales det, at der indledningsvis redegøres for de forventede gevinster ved indsatsen, hvorefter det vurderes, hvilke der kan værdiansættes. Udvælgelsen af, hvilke gevinster der medtages i beregningen af de samlede gevinster, bør være baseret på indsatsens forandringsteori og/eller tidligere evidens. Ved at afrapportere, hvilke gevinster der forventes inden selve beregningen, øges troværdigheden af den samlede cost-benefit-analyse.

Vi anbefaler at anvende benefit maps (Belfield et al. 2015) for at illustrere, hvilke gevinster en indsats forventes at have, herunder gevinster, der forventes på det korte og lange sigte. Benefit maps kan også tydeliggøre, om der kun forventes direkte gevinster på deltager (barn), eller der også forventes afledte effekter for andre familiemedlemmer (for eksempel barnets forældre eller søskende) eller andre (for eksempel de andre børn i børnehaven).

- **Redegør for hvilke gevinster, der kan henholdsvis observeres, værdiansættes og prædikteres**

Efter at have udarbejdet ovenstående diagram over forventede gevinster kan det angives, hvilke gevinster der kan henholdsvis observeres, værdiansættes og/eller prædikteres. Derved bliver det tydeligt for læseren, hvilke gevinster der er medregnet, og hvilke der forventes af programmet men ikke har kunne medregnes. Det øger ligeledes sammenligneligheden på tværs af programmer, at det er tydeligt, hvilke benefits der er medregnet.

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<sup>1</sup> Et eksempel på det sidste er samfundets gevinster ved en indsats, der på sigt reducerer ungdomskriminalitet. Her vil tilfalde private gevinster i form af, at den enkelte borger er mindre udsat for kriminalitet, og offentlige gevinster i form af færre udgifter til retssystemet.



- **Afrapportér effektestimater, der er værdiansat**

Det anbefales at afrapportere effektestimater (og deres standard fejl) for hver gevinst, der medregnes, og derefter tydeligt angive, hvilke af disse effektestimater der værdiansættes og medregnes i den samlede cost-benefit-ratio. På sigt ville denne anbefaling medføre, at det bliver muligt at replikere cost-benefit-analyser med andre priser eller antagelser, herunder sammenligne programmer, hvis de blev udsat for den samme cost-benefit-metode.

- **Afrapportér de samlede gevinster og opgjort for hver kategori**

Det anbefales, at de samlede gevinster afrapporteres sammen med en opgørelse på hver kategori af gevinster (for eksempel opgjort på kognitive gevinster, sociale/adfærdsmæssige gevinster, indkomst og kriminalitet) samt opgjort på stakeholderes (fx private, offentlige, samfundet). Derved sikres gennemsigtighed i forhold til, hvilke potentielle gevinster der er medtaget, og hvilke der er udeladt. Samtidig bør gevinst-estimerne vedlægges en beskrivelse af væsentlige antagelser, der kan have betydning for den samlede gevinstberegning, herunder afrapportere alternative gevinstestimater, hvor disse antagelser justeres (for eksempel afrapportere et nedre og et øvre estimat for gevinsten).

- **Beskriv værdiansættelsen (monetisation)**

Beskriv for hver gevinst, hvordan omregning fra punkttestimat til værdi i kroner er udført. For gevinster, der kan observeres i data, beskrives de observerede data (hvordan gevinsten observeres i data), estimationsmetoden (hvordan punkttestimatet er estimeret på baggrund af data) og skyggeprisen (hvordan punkttestimatet omregnes til værdi i kroner).

For langsigtede gevinster, der endnu ikke kan observeres i data, beskrives det seneste observerede data og punkttestimat (der anvendes til prædiktion af langsigtede forventede gevinster), estimation af punkttestimatet (der anvendes til prædiktion), prædiktionsmetoden (hvordan punkttestimatet fremskrives til andre langsigtede gevinster) og skyggeprisen (hvordan de prædikterede gevinster omregnes til værdi i kroner).

- **Anvend mikrodata til at estimere forventede langsigtede gevinster**

Det anbefales, at forventede langsigtede gevinster (for eksempel forventede livstidsindkomst) prædikteres på baggrund af mikrodata fremfor aggregerede nationale statistikker. Endvidere bør disse prædiktioner baseres på mikrodata om børn, der er sammenlignelige med de børn, der deltager i indsatsen.

## **COST-BENEFIT-RATIO**

- **Omkostninger og gevinster skal diskonteres til samme alder for de deltagende børn**

Diskontering betegner en omregning af omkostninger og gevinster, der finder sted på forskellige tidspunkter i barnets liv, til værdien på ét bestemt tidspunkt. Omkostningerne til indsatsen vil typisk finde sted i det første år efter indsatsens start, hvorimod de forventede kort- og langsigtede effekter vil finde sted løbende over barndommen eller i voksenalderen. Derfor bør omkostninger og gevinster tilbagediskonteres til samme år, typisk året hvor indsatsen starter. Men for at øge sammenlignelighed af cost-benefit-analyser af indsatser, der igangsættes på forskellige tidspunkter af et barns liv, anbefales det endvidere at tilbagediskontere til en bestemt alder (for eksempel som nulårig eller treårig). Afrapporteringen bør indeholde diskonteringsfaktor samt år eller alder, som der er tilbagediskonteret til.

- **Afrapportér følsomhedsanalyser**

Ovenfor fremgår en række overvejelser og antagelser, der kan have væsentlig betydning for estimerne på de samlede omkostninger og gevinster og dermed den endelige cost-benefit-

ratio. For cost-benefit-analyser af tidlige indsatser er der endvidere en større usikkerhed, da disse i høj grad må baseres på prædiktioner af forventede langsigtede gevinster i ungdommen og som voksen.

En cost-benefit-analyse af tidlige indsatser bør derfor afrapportere usikkerheden omkring det endelige cost-benefit-ratio. Det kan for eksempel illustreres grafisk ved at vise de alternative estimater for cost-benefit-ratioen, hvis de alternative estimater for de samlede omkostninger og gevinster er anvendt.

- **Afrapportér cost-benefit ratio**

Det anbefales at afrapportere den endelige cost-benefit-ratio sammen med de samlede omkostninger og gevinster særskilt, således at det er tydeligt, hvordan ratioen er fremkommet.

Anbefalingerne ovenfor lægger vægt på afrapportering, redegørelse for valg og antagelser og følsomhedsanalyser, hvor disse antagelser udfordres. Kortlægningen af litteraturen viste, at for overraskende mange studier er det ikke muligt selv at beregne den endelige cost-benefit-ratio på baggrund af de afrapporterede tabeller. Anbefalingerne skal derfor understøtte en større gennemsigtighed i udarbejdelsen af cost-benefit-analyser og derved muliggøre sammenlignelighed på tværs af studier og indsatser.

Det er dog også centralt at bemærke, at der er et trade-off mellem systematik og validitet. Hvis alle indsatser udsættes for den samme cost-benefit-beregning, kan vigtige forhold omkring den enkelte indsats ikke indarbejdes.

## Perspektiver for udarbejdelse af flere cost-benefitanalyser af danske indsatser på børneområdet

Denne rapport kortlægger de metoder, der er anvendt i cost-benefit-analyser af tidlige indsatser, der er udgivet i perioden 2007-2017. Kortlægningen viser, at der kun er 15 komplette cost-benefit-analyser, der indeholder en komplet metodebeskrivelse af, hvordan de samlede omkostninger og gevinster er beregnet. Kortlægningen viser også, at der mangler konsensus omkring, hvilke kortsigtede og langsigtede gevinster der medregnes, og hvordan de omregnes fra effektestimater til værdi i kroner. Flere studier forsøger dog at inkludere og værdiansætte flere forskellige kategorier af gevinster – herunder ”bløde” gevinster, der ikke naturligt kan opgøres i værdi i kroner (*non-monetary benefits*) som for eksempel færre symptomer på ADHD, forbedret sundhed eller reduceret ungdomskriminalitet.

Rapporten konkluderer, at der er brug for fortsat fokus på indsamling af systematisk data og evidens om sammenhænge mellem forbedring af børns udvikling i barndommen og senere outcomes, for at cost-benefit-analyser af tidlige indsatser til fulde kan medregne både kort- og langsigtede gevinster.

Baseret på kortlægningen fremlægges følgende forslag til videreudvikling af metoder og data til udarbejdelse af cost-benefit-analyser på børneområdet:

- Identificering og udvikling af danske skyggepriser, der kan anvendes til at omregne observerbare ændringer i børns udvikling til værdi i kroner. Det gælder for eksempel børns sociale udvikling, trivsel, adfærdsproblemer og relationer, som er de børne-outcomes, en tidlig indsats typisk er målrettet, og som måles og evalueres.

- Systematisk indsamling af data om børns udvikling, særligt i den tidlige barndom og førskolealderen. En systematisk dataindsamling er nødvendig for at kunne undersøge potentielle langsigtede gevinster, herunder:
  - Undersøge sammenhænge mellem børns udvikling og fremtidige outcomes
  - Undersøge sammenhængen mellem børns udvikling og deres forbrug af offentlige servicetilbud.
- Udvikling af brugen af danske mikrodata og statistiske metoder til at prædiktere forventede langsigtede gevinster, herunder hvordan usikkerhed medregnes.

# 1 Introduction

Decades of evidence demonstrate that early childhood programmes can benefit children, and potentially even yield long-term economic returns for the children and society. The economic returns have been estimated to be three-four dollars for each dollar invested in high-quality early childhood programmes operated in the 2000s (Karoly 2016)<sup>2</sup>. In this report, we describe the methodological framework for assessing the economic returns of early childhood programmes: cost-benefit analyses. Our aim is to identify best-practice of cost-benefit analyses and how they may be applied to evaluate early childhood programmes. We will not summarise the evidence of effects of early childhood programmes, nor will we compare cost-benefit rates across programmes.

Cost-benefit analyses describe the monetary value of a programme's benefits relative to its cost. Cost-benefit analysis (CBA) has gained increasing interest among decision makers as a tool to select among programmes aiming at improving children's skills and life trajectories. In this review, we describe the framework for cost-benefit analyses and the current state-of-the-art methods applied when assessing the benefits and costs of early childhood programmes.

Valuing costs and benefits in public spending is core in economic literature. In the 1960s, scholars introduced CBA of investments in education through human capital theory and rate-of-return analysis (see e.g. Becker). The empirical analyses were expanded to include the impact of education on earnings and returns to taxpayers in terms of productivity, tax revenues, health and public service savings. In the 1980s, data from follow-up interviews from some of the first early childhood programmes allowed scholars to apply CBAs to specific early childhood education programmes, such as Perry Preschool (Barnett 1985), Abecedarian (Campbell et al. 1998), and Chicago Child and Parents (Reynolds and Temple 1998). These were generally modal programmes, targeted at very disadvantaged children, and showed large economic returns. The cost-benefit analyses relied on follow-up data (age 15-21) and extrapolation to future earnings (based on children's education attainment). Since then, the range of included costs and benefits have expanded to include non-market-valued benefits, such as long-term improvements in health and reductions in crime activities (e.g. Temple and Reynolds 2007; Heckman et al. 2010). However, "soft" benefits that early childhood programmes aim to improve, such as behaviour and learning, are rarely included in economic evaluations.

Karoly and co-authors from RAND Labour and Population reviewed the literature in 2008 and provided recommendations for a standardised framework for cost-benefit analyses of social programmes, including early childhood programmes.<sup>3</sup> The framework included a monetisation of long-term economic, health and crime benefits. However, Karoly (2008; 2012) also concluded that there is a "*lack of standardization across CBA methods to date, although there is more agreement on some elements than others*". Especially, with respect to outcomes, the use of different measures, participants and time horizons in the various effect studies makes it difficult (or impossible) to value and project the same set of outcomes over the same future horizon across cost-benefit analyses. Karoly (2008; 2012) also emphasises that benefits in the domains of cognitive, emotional/behavioural development and education are most often left out, as there is no established agreement on how to assign a monetary value on these kinds of "soft" benefits (Karoly 2008; 2012).

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<sup>2</sup> Compares universal preschool programmes from different US states operated in the 2000s: California (Karoly and Bigelow 2005), Texas (Aguirre et al. 2006), Ohio (Belfield 2004), Massachusetts, Ohio and Wisconsin (Belfield 2006b), Arkansas (Belfield 2006c). The calculations are made from the societal or the government's perspective. See Karoly (2016: p. 49).

<sup>3</sup> Karoly's (2008) review is based on 39 social programmes evaluated by one or more of three selected research organisations. Of these, 10 studies evaluated early childhood interventions, whereas the remaining evaluated K-12 education interventions, general youth development interventions or other social policy areas.

The aim of the present review is to extend this line of research with the most recent applications and discuss the methodological progress made.

The objective of this review is to assess the state-of-the-art of measurement and estimation of benefits from early childhood interventions. To achieve this objective, we review and synthesise studies that provide a solid cost-benefit analysis. We identify the set of benefits and costs included and discuss development in estimation methods. We pay particular attention to methods and benefits relevant to early childhood programmes in Scandinavian public policies. In the protocol (November 2017), we formulated the following research questions:

Based on cost-benefit analyses published in the past decade (2008-2017), we will review:

- Which approaches are applied in the newest literature to extend the methodological framework of cost-benefit analyses to early childhood intervention?
- How is the impact from early childhood interventions under non-market and non-monetised programme's monetised and included in CBAs of early childhood programmes? This includes cognitive development, behavioural/emotional development and education and academic attainment.
- When follow-up sample data are not available, how are programme impacts translated (extrapolated) into long-term outcomes for the individual and for the society? This includes long-term economic benefits, reduced crime and substance abuse, and long-term health effects.

The literature search and synthesis consist of multiple stages. First, we systematically search electronic databases for studies related to early childhood programmes and cost-benefit analyses (1838 studies). The search results were independently screened by two reviewers and went on to full abstract review (1457 studies), if they met the eligibility criteria. We reviewed abstracts to assess the field and publication type and continued with all studies that discussed costs and/or benefits of early childhood programmes (390 studies). We then proceeded to extract information about the publication type and whether a cost-benefit analysis was conducted, which resulted in 126 studies for full-text reading to determine the quality of the cost-benefit analysis. After full-text reading of all studies that discussed cost-benefit analyses and early childhood programmes, we were left with only 15 studies that conducted a full cost-benefit analysis.

After reviewing these 15 cost-benefit analyses, our main findings can be summarised as follows: We find that well-established methods exist for programme cost collection and calculation and that there is a consensus in the literature that the "ingredient method" is recommended. However, this method appears to be difficult to implement in practice, and in a majority of the reviewed studies the costs are estimated retrospectively.

In the case of benefit calculation, methods are less established. Monetisation and inclusion of children's cognitive, behavioural and emotional development is rarely performed, and a main reason for this is that shadow prices for these domains are less developed/do not exist. A large share of the studies include observed or projected adult outcomes. A substantial number of the benefits are actually cost-savings as improved outcomes in, for instance, health and crime tend to decrease costs in these domains. We find that the later studies tend to include projections in more domains and that there is an increase in the use of microdata from various sources for projections.

We conclude that the field is (still) characterised by lack of standardisation regarding which benefits to include in the cost-benefit analyses and how these are to be monetised. This is largely due to a lack of data and the fact that it is not possible to assign monetary values on important outcomes of

early childhood programmes. This means that the availability of data will often determine which benefits it is possible to include and at which relevant shadow prices. Furthermore, a complete cost-benefit analysis to a great extent relies on projections of future benefits. Projection methods are still developing – and again the data availability is crucial for the quality of projections. Over time, the possibility of comparing *ex-ante* projections and *ex-post* actual observations improves, and such comparisons enable researchers to evaluate the quality of projection. Until now, studies comparing *ex-ante* projections with new *ex-post* observations have suggested that previous *ex-ante* projections were conservative. Furthermore, the lack of methodological standardisation in the performed cost-benefit analyses of early childhood programmes renders the results sensitive to a large and broad set of assumptions, thus making the cost-benefit results less comparable.

The report is structured as follows. Chapter 2 introduces the general framework for cost-benefit analyses of early childhood interventions. Chapter 3 describes our systematic literature search for cost-benefit analyses of early childhood programmes. We search systematically for cost-benefit analyses from the past decade to discuss the latest methodological applications in the field. The remainder of the report is based on the studies from the literature search. Chapter 4 discusses estimation of costs and the latest applications. Chapter 5 discusses general estimation of benefits from early childhood programmes, followed by Chapters 6 and 7, which focus on the monetisation of various childhood and adult benefits, respectively. Chapter 8 discusses central choices and addresses uncertainty in more detail. Finally, Chapter 9 summarises the findings of our review of the literature, concludes on the status of the literature of cost-benefit analyses for early childhood interventions and provides our recommendations for future development of cost-benefit analyses.

## 2 Methodological framework

Chapter 2 introduces the general framework for cost-benefit analyses and how this framework is applied to early childhood interventions.

### 2.1 Economic evaluations

Economic evaluations may be conducted from different perspectives and have different objectives. Costs are naturally considered in monetary values but the potential benefits of a programme may be considered in various metrics and with different emphases. Cost-benefit analyses are one type of economic evaluation. In this section, we briefly describe different types of economic evaluations, of which some are often confused with cost-benefit analyses without actually being a real cost-benefit analysis.

Economic evaluations of early childhood programmes may be conducted using the following assessments:

- **Programme evaluations (impact evaluations)**

Studies that estimate the impact of a programme. Programme evaluations aim at causal identification of one or more benefits of a programme. Programme benefits are assessed using various outcome measures and are only rarely monetised. Programme costs may sometimes be reported.

- **Cost analyses**

Studies that report only the cost of a programme. Cost analyses allow for comparisons of costs of different early childhood programmes but do not take into consideration the benefits of the programmes.

- **Cost-savings analyses**

Studies that measure net savings to the government only. Cost-savings analyses include both costs and benefits of a programme, but only those for the state or government (i.e. for the funder of the programme).

- **Cost-effectiveness analyses (CEA)**

Studies that measure the ratio of a programme's benefits to its costs, but benefits are expressed in a common outcome measure (e.g. test scores, translated to effect sizes) and are not assigned a monetary value. Programme costs are reported in a monetary value. Programme benefits can thus be divided by programme costs to obtain the cost-effectiveness ratio (CE-ratio).

- **Cost-benefit analyses (CBA)**

Studies that measure the ratio of a programme's benefits to its costs, where both benefits and costs are expressed in monetary values (dollar values). Programme benefits are translated into monetary values using market prices or shadow prices. Programme costs are reported in a monetary value. Programme benefits can thus be divided by programme costs to obtain the cost-benefit ratio (CB ratio).

- **Cost-benefit models**

Models designed to support policy and legislation. Models are designed to produce estimates of costs and benefits of various public policies. For example, the cost-benefit model from The Washington State Institute for Public Policy (WSIPP), designed to inform Washington State's legislature.

The main objective of programme evaluations is to evaluate whether the programme “works”, meaning whether the programme provides the intended gain for the participating children (for example improving vocabulary from a reading programme in preschool). This is typically evaluated using the primary measures observed immediately or shortly after the programme has ended (e.g. test of vocabulary). Follow-up studies may show whether the programme impacts persist and eventually spill over to other benefits as time passes (e.g. school readiness and later reading skills). However, an impact evaluation does not necessarily include any monetisation of costs or benefits and thus does not show whether the programme “is worth its costs”.

When choosing which programme, among various potential early childhood programmes, to invest in and expand to more children, we are interested in finding the programme that has the greatest impact or is the most effective.

Cost-effectiveness analyses compare programmes’ effectiveness in terms of some common objective (outcome). This is typically a non-monetary value, but translated to effect sizes to obtain a comparable measure across programmes. An examples could be which programme is best at improving children’s school readiness (measured by enrolment on time), achievements (measured by test scores) or behavioural development (e.g. measured by symptoms of behavioural problems). This requires the programmes we are interested in to be evaluated using the same type of outcome measures. These outcomes are typically non-monetary and are thus not directly related to the monetary costs of the programme. The benefits (in terms of observable outcomes) are typically translated to effect sizes in order to have a common unit across programmes (Bloom et al. 2008; Lipsey et al. 2012). Then, programme benefits can be divided by programme costs to obtain the cost-effectiveness ratio (CE ratio).

Cost-benefit analyses compare programmes’ effectiveness in terms of monetary values, monetising both the costs and benefits of the programme. This makes it possible to compare across early childhood programmes that do not necessarily evaluate the same outcome measures. In addition, it is possible to compare programmes in early childhood with, for example, a programme in school or later in life, making it possible to obtain information about investing early compared to later in life. As we will see later, however, a challenge is that it is very difficult to monetise many of the outcomes that we aim to improve with early childhood programmes, which makes cost-benefit analyses difficult to carry out and compare.

Moreover, different elaborations of cost-benefit analyses exist. Many cost-benefit analyses are done from the perspective of the programme funder only (e.g. a childhood organisation, the local community or the state), where they consider the costs and benefits from their own perspective only, i.e. consider whether potential future cost-savings outweigh the costs of running the programme (see e.g. Morris et al. 2013). An example could be a local community focusing on preparing children for school to save costs on delayed school entry. Cost-savings analyses from the perspective of the government consider the costs and financial benefits realised by the government (e.g. Maher et al. 2012; Johnson-Motoyama et al. 2013). Only the costs to the government are taken into account, and the benefits are those that are actual dollar savings. Karoly et al. (2001) describe this kind of analysis as used to determine whether a publicly provided programme “pays for itself” (in financial terms alone). Other evaluations provide a cost-analysis of the programme only (e.g. Bowden et al. 2018 for a reading programme).

Finally, economic evaluations are used as inputs (evidence) in different types of public policy cost-benefit models designed to support local or national policy decisions, or even for government legislature (Belfield, Bowden, and Rodriguez 2018; Aos et al. 2004).



One example is the cost-benefit model available from The Washington State Institute for Public Policy (WSIPP) (Aos et al. 2004). The WSIPP model includes databases that combine effect sizes from meta-analyses of evidence-based social programmes, estimates of long-term benefits from social programmes (links) and cost estimates. The WSIPP model is publicly available and allows the users to conduct cost-benefit analyses of their own programmes. Similar resources are available from other research organisations working with social programmes, e.g. J-PAL (see the list of centres in Table A1.2); some include public and individual benefits, others only public benefits. WSIPP is, to our knowledge, the most developed and advanced model for systematic cost-benefit assessment across social programmes. Another example is cost-benefit models estimating public net savings from early childhood programmes (e.g. the Danish model for social investments (SØM)).<sup>4</sup> However, it is beyond the scope of this review to consider how these models are developed or structured.

Models designed to support or inform policy makers about return to early childhood programmes (and other social programmes) should be based on causal evidence. In this report, we review best practice for conducting cost-benefit analyses of evidence-based early childhood programmes (i.e. backed by a causal impact evaluation). The best practice methods reviewed are not necessarily applicable to all early childhood programmes. As the review will show, cost-benefit analyses are very data dependent, and a broad set of assumptions and choices are made for each specific early childhood programme. Thus, building one big cost-benefit model to perform a set of cost-benefit analyses on all early childhood programmes will require methodological compromises. It is beyond the scope of this review to provide recommendations regarding this.

To sum up, economic evaluations of early childhood programmes can have many different forms and purposes. In this report, we review only full cost-benefit analyses that monetise benefits and costs (public and individual) and are able to report a cost-benefit ratio.

## 2.2 Framework for cost-benefit analyses

Cost-benefit analysis (CBA) examines the rate of return of an intervention. Cost-benefit analyses include the costs and benefits for the participating individuals, the tax payer (public sector) and the society in general.

Cost-benefit analyses may be conducted from different perspectives. As described above, some cost-benefit analyses are made from the perspective of the programme funder only, where the impact evaluation may show improvements in children's skills but does not put an economic value on these improvements and thus only considers the cost and benefits from the perspective of the programme funder (see e.g. Morris et al. 2013). Other studies are cost-savings analyses that are restricted to the costs and financial benefits realised by the government (e.g. Maher et al. 2012; Johnson-Motoyama et al. 2013). Only the costs for the government are taken into account, and the benefits are those that can be expressed in dollar savings. Karoly et al. (2001) describe this kind of analysis as used to determine whether a publicly provided programme "pays for itself" (in financial terms alone).

We follow the terminology in Karoly (2008) and investigate the cost-benefits from the societal perspective rather than the programme perspective, as this gives a more complete view of the aggregate costs and benefits of public interventions, which include the costs and benefits for the individual (programme participant) as well for those who do not receive the programme. A cost-

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<sup>4</sup> Other models focus on the individual benefits. For example, life-cycle models to estimate improvements in children's life following interventions at different ages (e.g. the Social Genome Model from Brookings Institute (Sawhill et al. 2014)).

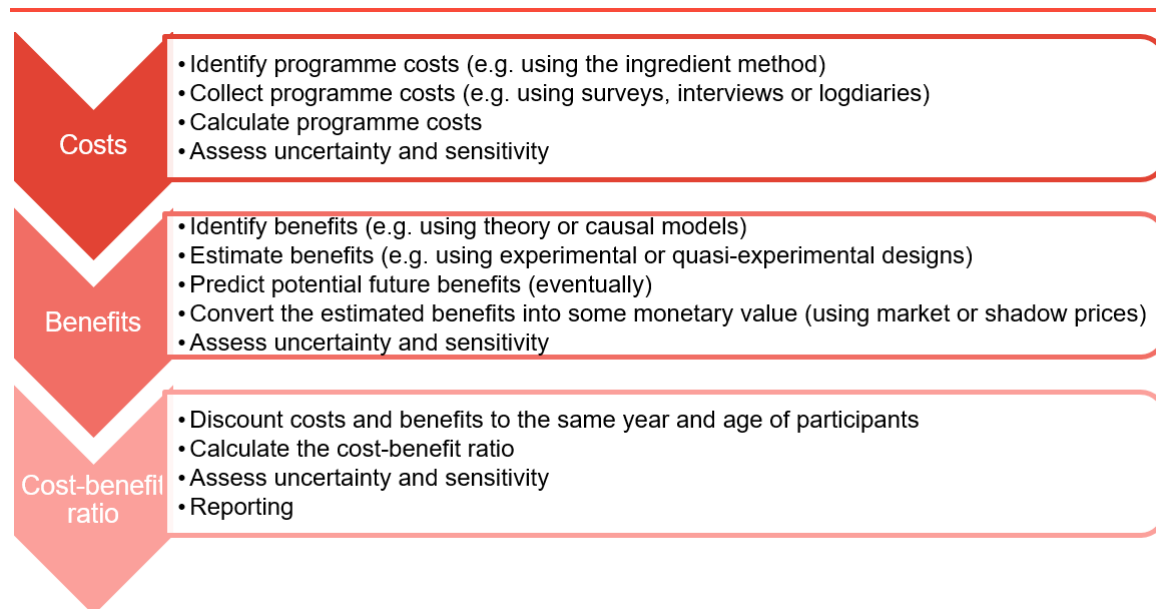
benefit analysis includes the costs and benefits for the participating individuals, the taxpayer (public sector) and society in general. To get a full picture of the aggregate costs and benefits of a public intervention, it is recommended to report the total cost and benefits at the disaggregated level to illustrate the costs and benefits from each perspective (i.e. the perspective of the individual, the taxpayer and society).

A cost-benefit analysis involves the following overall steps:

1. Identify and calculate the cost of the programme
2. Identify and estimate the benefits of the programme, expressed in monetary terms
3. Calculate the cost-benefit ratio:  $\frac{\text{Benefits of the program (measured in kr.)}}{\text{Cost of the program (measured in kr.)}}$

Each step is broken down into multiple steps and decisions that will affect the final cost-benefit ratio. This is illustrated in Figure 2.1

**Figure 2.1** Framework



Note: The figure shows the steps involved in assessing the costs and benefits before calculation of the cost-benefit ratio.

The costs are obtained from a programme description and records from the party that implemented and operated the programme. The main challenges for the cost calculation are to identify and collect the actual costs of a programme. We will describe the ingredient method, which is the preferred method for calculating costs in Chapter 3.

Benefits are the estimated impacts of the programme. Benefits can be positive or negative. Benefits may include benefits for the individual and for society, including benefits in terms of cost savings in public services (e.g. health services) and welfare. An example of a negative benefit is increased enrolment in higher education. Whereas costs are naturally expressed in monetary terms, this is not always the case for benefits. The main challenges for the benefit calculation is thus to assign a monetary value to the various types of soft benefits that may arise from participation in early childhood programmes. A second challenge is that many benefits may not yet be observable for the researcher. The researcher then has to predict future benefits based on observable impact measured in the short-run. A number of methodological considerations arise when applying

projections to future outcomes, such as considering which benefits to include, making sure the impacts do not overlap and how to extrapolate impacts to future outcomes.

In general, results of cost-benefit analyses of social programmes are sensitive to various methodological choices, such as the time horizon, discount rate, extrapolation techniques, which programme benefits are included and expressed in monetary terms, the monetary values assigned to valued outcomes, inclusion of benefits, costs for various stakeholders and capturing uncertainty associated with cost-benefit estimates. The review from Karoly (2008) concluded that there is no consensus on these choices in the field. In the following chapters, we discuss these choices and how they are handled in recent cost-benefit analyses.

## 3 Literature search

This chapter documents the design and execution of the systematic literature search. We searched for cost-benefit analyses (published between 2008 and 2017) from the past decade that contain a cost-benefit analysis of one or more early childhood interventions. We also describe the process of identifying which studies to include in the review and the strategy used to map and quality assess the relevant studies.

### 3.1 Objectives, inclusion and exclusion criteria

Our aim is to identify cost-benefit analyses of early childhood interventions.

We define early childhood interventions as programmes that target children in the years before school entrance.<sup>5</sup> This includes home-visiting programmes and programmes in nurseries, day cares, child care centres and preschool. Some programmes may even start before birth (e.g. parental training programmes). The programmes may either be targeted at specific groups of children or families (e.g. children of disadvantaged families), geographical areas (e.g. community family centre) or universal (e.g. preschool).

We search in the fields of social sciences: economics, public policy, psychology and sociology. We exclude development economics, public health interventions, medicine and clinical trials.

We define cost-benefit analyses as studies that assess and report the programme's costs and benefits in monetary values. We exclude the following types of studies:

- Studies that only consider either the costs or the benefits of a programme
- Cost analyses: Studies that report only the cost of a programme
- Cost-savings analyses: Studies that measure net savings for the government only
- Cost-effectiveness analyses (CEA)
- Impact analyses that do not monetise impacts or report a cost-benefit analysis.

See Section 2.1 for a description of the above. Cost-effectiveness analyses (CEA) evaluate effectiveness in terms of some outcome value, not monetary values of the benefits. Because our focus is on cost-benefit analyses and the use of shadow prices to determine the economic value of soft outcomes, we do not consider cost-effectiveness analyses (CEA).

These types of studies will typically also be based on an electronic database search including the words "costs" and "benefits". It requires a comprehensive data extraction to classify studies accordingly. We describe the data extraction below.

The inclusion criteria outlined in this section were developed to meet objectives and research questions formulated in Section 1. The outlined criteria and research questions constitute the basis for our search strategy. Only studies meeting all inclusion criteria are included in the systematic review and subject for quality appraisal.

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<sup>5</sup> In an American context: before entry into K-12 education (compulsory education). In a European context: before entering primary education.

We search for studies published between January 2008 and December 2017 (both months included), since our aim is to document methodological advances since Karoly (2008).

The inclusion criteria and their rationales are described in Table A1.1.

## 3.2 Search strategy

The search strategy was developed based on the research questions proposed in Section 1 and the inclusion criteria outlined in Section 3.1.

We searched in the fields of social sciences: economics, public policy, psychology and sociology.

We searched for literature in the electronic bibliographic databases EconLit, ERIC, IDEAS/RePEc, Sociological Abstracts, Social Sciences Citation Index (Web of Science), SocINDEX and Academic Search Premier.

The search terms included words related to cost-benefit analysis and early childhood programme or intervention.<sup>6</sup> We searched on MESH terms and words included in titles, abstracts and keywords, with the precise strategy and terms adapted to match the specific databases and webpages.

The search strategy was developed in cooperation with VIVE's librarian and search specialist, who was also responsible for performing and documenting the various searches.

In addition, we manually searched for cost-benefit analyses from research/policy centres and organisations working with (providing evidence on) early childhood programmes, such as the Center for Benefit-Cost Studies of Education. The aim is to identify cost-benefit analyses or methodological resources (e.g. guidelines) that are not found in electronic database searches but provide examples of best-practice in the field. In particular, discussions related to cost-benefit analyses of early childhood interventions in the Scandinavian welfare states, as other types of costs and benefits may be considered in these studies compared to American studies. Hence, we also manually searched the websites of various Scandinavian research institutions and databases.

See Table A1.2 for a complete description of the search strategies.

## 3.3 Search results and identification of relevant studies

The search strategy described in Section 3.2 resulted in a total of 1,838 potentially relevant publications. After the first screening, we had 1451 unique studies (see Table A2.1). The following screening and sorting is illustrated in Figure 3.1.

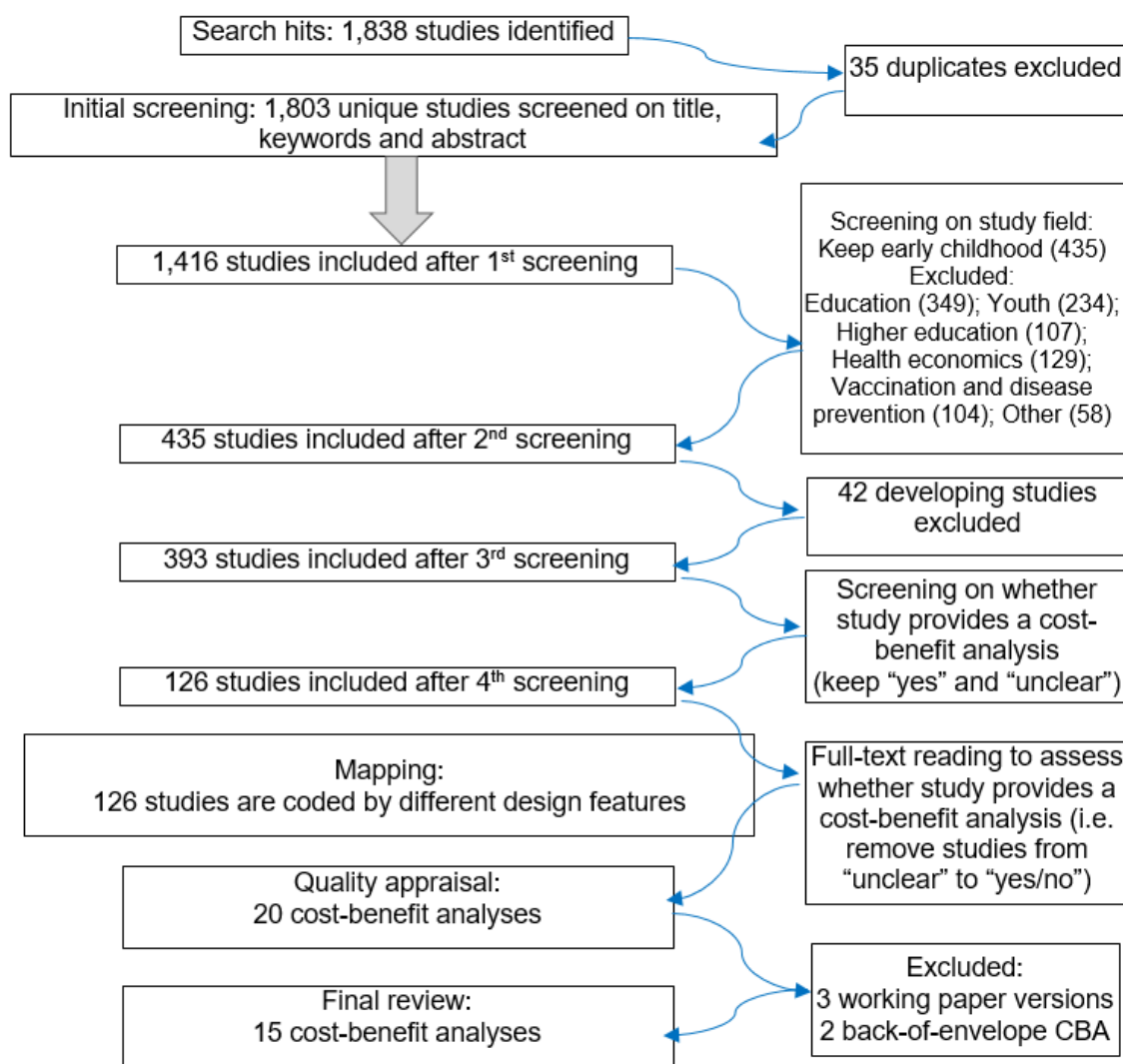
Initially, we screened studies based on title, keywords and abstracts and kept all studies describing cost-benefit analyses or evaluations of benefits and/or costs of early childhood programmes. We screened multiple times, but for many studies reading abstracts was not sufficient to assess whether they provide a cost-benefit analyses. We download and read studies to determine whether they provide a cost-benefit analysis.

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<sup>6</sup> The initial search strategy also included terms related to school and vocational training, reflecting the fact that it was not restricted to early childhood but designed to identify CBA studies of social programmes aimed at children aged 0-18 years. This followed the definition of social programmes by Karoly (2008). However, due to the large search return (1838 studies) we restricted the objective to early childhood programmes and excluded studies related to K12 education and youth programmes.

Figure 3.1 illustrates the process from database search to screening and mapping (further details can be seen in Appendix 1, including the exact search terms and screening results).

**Figure 3.1** Overview of the process from literature search to identification of full cost-benefit analyses



Note: The figure shows information from searches performed in several databases and screenings together, and the numbers related to search hits and screening results are approximates.

The figure illustrates that the decision to focus on early childhood interventions was made after the 1<sup>st</sup> screening. At the 3<sup>rd</sup> screening, we also excluded studies from developing countries in order to focus on interventions and outcomes that are relevant in the context of economic welfare states like those in Scandinavia. We then proceeded to identify relevant cost-benefit analyses. Our aims were to i) identify cost-benefit analyses and ii) discuss methodological advantages. At the 4<sup>th</sup> screening, we excluded studies mentioning costs and benefits in the abstract, whereas screening of the papers showed that no cost-benefit analysis is reported or described. Many studies turned out to merely provide a discussion of the research or policy rationale behind cost-benefit analyses without actually conducting an analysis.

We were then left with 126 studies that have been full-text read, mapped and quality appraised with respect to the content of the cost-benefit analysis. The mapping strategy is documented in Appendix 2. We found large variety in the content and quality of the costs-benefit analyses and re-categorised a number of studies. For example, a number of studies that included state-level cost-savings analyses only (removed to cost-savings analyses), papers that discussed evidence from other cost-benefit analyses only (removed to policy briefs; e.g. Hite 2014) and papers that included an impact evaluation only (experimental or quasi-experimental) but with no monetisation of costs or benefits. For a full list of search results on publication types, see Table in Appendix 2.

The complete mapping of search results by publication type is reported in Appendix 2.

### 3.4 Quality appraisal of cost-benefit analyses

In the process described above, we identified 20 studies that provide a cost-benefit analysis. Excluding three that are working paper versions and two that are merely back-of-the-envelope calculations, we arrived at 15 cost-benefit analyses for review. We proceeded to synthesise the contents and quality of these studies. The remainder of the report will be based on these analyses.

The final result of the literature search includes:

- 20 cost-benefit analyses (i.e. studies that estimate and report a cost-benefit ratio)
  - 15 studies: studies with methodological contributions
  - 3 studies that are working paper versions of the above
  - 2 studies of low quality: studies that merely include a simple back-of-the-envelope CB calculation or a very simple or incomplete CBA (excluded from the review)
  - 12 methodological papers on cost-benefit analyses of early childhood programmes describing frameworks or specific methodological techniques (e.g. discounting or uncertainty).

To sum up, the systematic literature searches and synthesis identified 15 full cost-benefit analyses that included a complete analysis and reported a cost-benefit ratio. These 15 cost-benefit analyses are subjected to further review in the following chapters. Two cost-benefit analyses were excluded because they were no more than simple back-of-the-envelope calculations.

The methodological papers are referred to when relevant, but not included in the review tables below.

## 4 Costs

In this chapter, we focus on the programme costs. We provide a definition of programme costs and describe recommended methods to collect and estimate costs. The chapter takes as its point of departure Levin and McEwan (2002) and Belfield et al. (2015) and is supplemented with applications from our literature search.

When deciding what to include in the calculations of costs, it is important to note that *expected cost savings* on children's future use of the education system and other public services are considered *benefits*. In other words, they are included in the calculations of benefits, not the calculations of costs, of the early childhood programme, see Chapter 5.

### 4.1 Programme costs

Cost calculations should ideally:

- encompass all costs, including material costs, personnel costs, capital costs and in-kind costs
- be collected by authoritative or objective observers
- be collected when costs are incurred, i.e. during or just after the programme has run.

The main challenge is to identify which costs are relevant and to account for all relevant cost. In the general cost-benefit framework, the recommendation is that the costs should show the incremental costs arising from the intervention compared to treatment as usual, including:

- Administrative and capital costs (e.g. classroom facilities and utilities)
- Operational cost (e.g. teacher salaries and teaching materials)
- Opportunity costs (e.g. parents' lost income from work when participating in family sessions).

However, for early childhood programmes the calculation of the programme's total incremental costs depend on the programme content and implementation. Costs of an early childhood programme should reflect the incremental costs only, i.e. additional costs required for the programme.

Administrative and capital costs are included, if the programme requires capital to open new facilities, e.g. a preschool or family community centre, for example, the opening of Perry Preschools in the 1960s, where classrooms and other facilities were non-existing. The initial programme cost calculation from Barnett (1996) includes operational costs (teacher salaries and administrative costs) and capital costs (classrooms and facilities).

Operational costs are included in the programme cost if they represent additional costs required to run the intervention, such as teacher training and games or toys for a specific child development curriculum. However, early education programmes complicate cost calculations, when the programme is integrated as part of the existing curriculum or expected to be carried out by the professionals during normal hours in the preschool or child care centre, for instance in the case of a programme aiming to strengthen the focus on socio-emotional development during daily routines in the child care centre. How are the incremental costs of this programme to be calculated? On the one hand, no additional costs are invoked by the intervention (neither additional teacher staff, teacher salaries nor teaching materials). On the other hand, time spent on one intervention (e.g. socio-emotional development) may take time away from other activities (e.g. reading and language development), all else being equal. The recommended approach in this case is to include the



opportunity cost of the resources required in the programme's costs (Levin and McEwan 2002; McEwan 2012; Belfield et al. 2015), for example, the value of the staff's time spent on the activity.

Other potential opportunity costs of the early childhood programme should also be included. For example, a programme aimed at the child-parent relation or parenting skills must include the opportunity cost of the parent's time, typically valued by the lost labour income from time spent on transportation and programme activities. Later, we will provide examples of how these are estimated.

## 4.2 Reporting of programme costs

The programme's costs and benefits must be reported in a consistent manner. It is recommended to report all dollar amounts of future costs and benefits as present values (discounted) to the year in which the intervention began. This also applies for the opportunity cost of the resources required, which are discussed above. This should be done in order to account for the fact that money expenditures that took place earlier, as reflected in opportunity costs, are given greater weight by society (Levin and McEwan 2002).

Measuring the programmes costs and benefits in a common unit enables aggregation of costs and benefits in dollar values, across all stakeholders, and allows for comparison across different early childhood interventions. This is illustrated in Belfield et al. (2015), where programme costs of six different programmes for socio-emotional development are systematically collected and estimated. A discount rate of 3.5% is applied to all future costs and benefits. Dollar values are adjusted for inflation and reported in 2013 prices for all six programmes. Programme costs (and later the calculations of CB ratios) then become transparent and comparable across programmes.

Reporting of costs should also include relevant sensitivity tests – e.g. lower and upper bounds on costs that are sensitive to assumptions or applied prices – which is also exemplified in the cases from Belfield et al. (2015) mentioned above.

## 4.3 Collection of programme costs

To obtain the most reliable cost estimates, these should be collected while the intervention is in operation and preferably using the ingredient method. The ingredient method specifies each element, or ingredient, spent on the programme. The ingredients may be collected through:

- Interviews with operating heads (see e.g. Belfield et al. 2015; O'Neill 2013)
- Surveying professionals (see e.g. Garcia et al. 2016; Lynch et al. 2014)
- Logs, diaries etc. kept by participants (see e.g. Belfield et al. 2015; O'Neill 2013 using cost diaries).

In the following subsection, the ingredient method is described, followed by concrete examples of various other collection methods from our review.

### 4.3.1 The ingredient method

The ingredient method, which relies on the concept of opportunity costs, is the recommended cost estimation method. All costs required to implement and run the specific programme are collected,

in addition to business-as-usual. The method is typically employed for educational interventions (Levin and McEwan 2001).

The ingredient method involves three basic steps:

1. Ingredients: identification of all the ingredients required to implement the intervention (i.e. inputs)
2. Costs: estimation of the cost of those ingredients (i.e. inputs \* prices)
3. Reporting: total programme costs and programme cost per child (discounted to the year the intervention started).

The ingredients necessary to implement an intervention include the personnel, materials, equipment and facilities required, as well as any associated indirect support, such as maintenance. For example, the ingredients identified for a classroom intervention might include the paid and unpaid personnel who deliver the intervention (e.g. teachers, aides, special educators and volunteers), the materials and equipment required (e.g. textbooks, curriculum guides and iPads), the facilities that provide the setting (e.g. classroom, playground and community centre) and the indirect support associated with these primary ingredients (e.g., facility utilities and a share of the time of school administrative personnel). Ideally, everything required for running the intervention is included, even those inputs that are not part of the intervention itself, such as transportation to the intervention site (e.g. by parents).

The dollar value of each ingredient is then estimated using, for instance, actual cost as purchased, market value or opportunity costs (see Levin and McEwan 2001 for a discussion of various adjustments to costs, e.g. depreciation or inflation). It is crucial that all costs are systematically identified, and this typically requires multiple data sources. If there are multiple intervention sites, the distribution of resource use and costs across sites should be collected as well (see e.g. Belfield et al. 2015: Table 3 reporting distribution of ingredients and costs across three intervention sites). It is recommended to discount all costs to the start year of intervention, i.e. for costs occurring in later years after the year the intervention started.

Finally, the cost of each ingredient can be aggregated into a total cost estimate for the intervention. The cost estimate is then suitable to be used in the calculation of the CB ratio.

#### 4.4 Review of cost collection methods in the past decade's CBAs of early childhood programmes

Table 4.1 overview costs reported and collected in the past decade's cost-benefit analyses. The table shows that the majority of the reviewed cost-benefit analyses (13 studies) explicitly report the programme costs, but only four are clear on inclusion of opportunity costs. Furthermore, six cost-benefit analyses use the cost estimate from the initial impact evaluation, which reflects the fact that the majority of the studies are long-term studies following up on previous experiments evaluating early childhood programmes.

While the Ingredient Method is generally acknowledged as the optimal collection method, the cost estimations found in the literature search are rarely conducted in this way due to a lack of detailed data sources, a challenge that Bartik et al. (2011) also mention in their study. The majority of the studies collect costs retrospectively from various data sources and attempt to make the data reliable and accurate by adjusting for inflation and using a 3-7% discount rate.

**Table 4.1** Cost-benefit analyses: Cost methods

Study	CB ratio Reported	Programme Costs Reported	Opportunity Costs Included	Cost Collection Method	Cost Description
Kline et al. 2016 Head Start	Yes	Yes	Unclear	Retrospective; Review national admin. data and Head Start Fact Sheet	Calculates the net costs for the government of financing preschool. The authors set up a model equation for the net costs for the government of financing preschool (Kline et al. 2016: p.1814). Includes the following: a) Fixed cost of administering the programme b) The administrative cost of providing the services to an additional child c) The administrative cost for the government of providing competing services d) The revenue generated by taxes on the adult earnings of the programme-eligible children.
Bartik et al. 2016 Tulsa Universal Pre-K program follow-up study	Yes	Yes	Unclear	Retrospective; Review state or local admin. data	Compares calculated costs of the programme from three sources: state, local and programme. Programme costs only.
Belfield et al. 2015 Six interventions aimed at socio-emotional learning	Yes	Yes	Yes	Ingredient method  By reviewing programme descriptions, resource use and programme logs	Identifies the incremental costs of introducing the programme into regular, existing school activities. Costs are adjusted for inflation using the CPI-U into 2013 prices. Costs include personnel, facilities, materials and equipment. Cost collected from teacher logs, state administrative data and accounting records.
Heckman et al. 2010 Perry Preschool Program	Yes	Yes	Unclear	Costs collected from original evaluation	Uses estimates of the initial programme costs reported in Barnett 1996. Estimates include operating costs (teacher salaries and administrative costs) and capital costs (classrooms and facilities). Further educational costs are included (tutoring, special education, etc.).
Garcia et al. 2016 Carolina Abecedarian (ABC and CARE)	Yes	Yes	Unclear	Costs collected from original evaluation	Re-estimation based on primary-source documents. Programme costs calculated as total costs including welfare costs.
Bartik 2013 Ready 4s program	Yes	No	No	Unclear	Sole focus on total cost of the programme. Not explicit what the total costs are or where the information was found.
Reynolds et al. 2011 Chicago CPC	Yes	Yes	Yes	Costs collected from original evaluation	Programme costs estimated in Reynolds et al. 2001; Incremental costs of this programme add onto regular pre-school operation; Include all costs for the taxpayer, parent, opportunity costs etc.
White et al. 2010	Yes	Yes	Unclear	Costs collected from	Programme costs are only reported as average CPC programme costs; no details provided (White et al. 2010: Table 7). Costs are discounted to age 3.

Study	CB ratio Reported	Programme Costs Reported	Opportunity Costs Included	Cost Collection Method	Cost Description
Chicago CPC preschool				original evaluation	
O'Neill et al. 2013  The Incredible Years Parenting Programme	No	Yes	Yes	Cost collected during programme	Unit costs (e.g. travel by ambulance, speech therapist, social worker) collected via interviews, use of public service, official government data and so called 'cost diaries' kept by group facilitators (recurrent costs associated with implementation of the programme).
Zerbe et al. 2009  The Casey Family Programs	Yes	Yes	No	Costs collected from original evaluation	Calculates costs based on material from Edgebert et al. 2004.
Tiba and Furak-Pop 2012  CBT programme for children in risk of family separation	No	Yes	No	Retrospective; Review state or local admin. data	Costs were calculated based on data from the financial department, which described the state's total cost of service.
Lynch et al. 2014  Multidimensional Treatment Foster Care for Preschoolers	No	Yes	No	Costs collected during program	Include costs to all public agencies serving the population: health, social welfare, and education. Costs estimated based on clinical trial records, study staff estimates, study accounting records (e.g. pay roll costs, costs of facilities). Costs related to staff supervision, time spent developing treatment plans and staff training are also included.
Bartik et al. 2012  Tulsa Universal Pre-K program	Yes	No	Unclear	Retrospective; Review state or local administrative data	Programme costs derived from federal aid, state aid (state aid formula applied to students with different characteristics) and local support. In addition, data from Reynolds et al. 2011, Schweinhart et al. 2005 and Barnett and Masse 2007.
Schweinhart et al. 2013  HighScope Perry Preschool Program	Yes	Yes	Yes	Costs collected from original evaluation	From Belfield et al. (2006)
van Huizen et al. 2016  Universal preschool educational reform in Spain	Yes	Yes	No	State administrative data	Estimates the cost per child on annual public expenditure per student on pre-school post reform, plus average additional costs per child. Uses 2007 estimates, using OECD CPI to adjust for inflation and estimate the 1997 costs per child.

Note: This table reports the programme cost estimations used in the 15 cost-benefit analyses. Admin. data: Administrative data

Collecting costs retrospectively makes it harder to collect and specify all ingredients. Table 4.1 reports the approaches to collecting and estimating programme costs in the reviewed cost-benefit analyses. These vary from using the programme cost reported in the original impact evaluation to reviewing old programme logs or programme budgets. The following approaches are used:

- Apply cost estimate from original impact evaluation (e.g. Reynolds et al. 2011; Garcia et al. 2016; Schweinhart et al. 2013)
- Review cost collection from trial (see e.g. Long et al. 2015; O'Neill et al. 2013)
- Review programme description and resources used (see e.g. Belfield et al. 2015)
- Review national, state or local administrative data (van Huizen et al. 2016; Tiba & Furak-Pop 2012; Heckman et al. 2010a).

For example, Long et al. (2015) identified the ingredients for implementation of the 4Rs programme through review of documents from the impact evaluation (e.g. teacher logs on what they did each day), programme budgets and interviews with the programme's director and accountant. They did not interview teachers or principals directly.

As mentioned, most studies estimated costs retrospectively, whereas others used estimates from original reports or impact evaluation. Although not explicitly specifying use of the ingredient method, a number of studies provide a thorough estimation specifying separate inputs and costs.

As an example of costs estimated based on original impact evaluations, Garcia et al. (2016) base their cost estimations on progress reports by the principal investigators as well as primary-source documents. They consider the total programme costs (welfare cost of taxes, staff costs and transportation costs), health costs, crime costs and education costs. They adjust for inflation and use a 3% discount rate. As for the ingredient method, Garcia et al. (2016) explicitly outline what is included in the different cost estimations and the source of the information.

Similarly, Reynolds et al. (2011) base their per-participant cost estimations on the specific programme estimations from an earlier study conducted in 2001. These estimates are in turn derived from operational budgets from specific public schools, and in Reynolds et al. (2011) these estimates are adjusted for inflation and a discount rate of 3% is applied. In the calculations, they add the incremental cost of the programme to the regular pre-school operation, which in part consists of taxpayer costs, including, for instance, all outlays for staff, family and community support, capital depreciation and interest, and parent opportunity costs. As in Garcia et al. (2016), Reynolds et al. (2011) explicitly state what is included in the estimates and the source of the information.

O'Neill et al. (2013) collects costs during the programme by various means. In order to estimate the frequency with which educational, health and social services were used by parents, face-to-face interviews were conducted with the main caregivers before the intervention began and six months later. Service unit costs were estimated on the basis of various administrative sources. Furthermore, direct recurrent costs per parent are included and estimated via 'cost diaries' kept by group facilitators each week of the programme, including all recurrent costs involved in implementing the programme summarised as direct wage costs, other costs and travel costs. The strength of this paper is that the cost estimations are based on cost collection during the programme, and are not retrospective cost collection.

Tiba and Furak-Pop (2012) uses a retrospective collection method, obtaining the actual total cost of service during 2012 from the Financial Department. The authors calculate actual service costs per child by dividing the total cost of the service by the total number of children in the programme. Unfortunately, the study does not state what is included in the total cost of service.

Lynch et al. (2014) collects the costs during a randomised controlled trial (RCT) involving 117 children. The families report their use of usual care services in a survey designed specially for the study. The value of each service is estimated using public unit costs. The study estimates the total costs of the intervention using estimates from the staff participating in the RCT, including costs of

staff supervision, the time spent developing treatment plans, staff training and time spent delivering the services. Payroll costs, cost of facilities and purchases of goods and services are also included and estimated based on accounting records.

To sum up, costs estimates used in cost-benefit analyses should reflect the opportunity costs of resources used in the intervention versus business-as-usual or another intervention. Inputs should be counted as incremental, i.e. what is required in addition to business-as-usual. Applying the recommended ingredient method highlights the importance of including opportunity costs in the total cost estimates of an early intervention programme. As mentioned earlier, an example of how this can be done can be seen in O'Neill 2013. Cost diaries made it possible to keep records of time spent, e.g. on recruiting families via home visits or telephone calls, preparing group sessions, and costs incurred through, for instance, provision of crèche facilities. Furthermore, Reynolds et al. (2011) report opportunity costs in terms of parent's opportunity costs.

We find that in the past decade, methods for collecting programme costs have become more established compared to earlier. Moreover, resources (online tools) for collecting programme costs are publicly available, e.g. from the WSIPP model (WSIPP 2017) and from the Center for Benefit-Cost Studies of Education (the CBCSE Cost Tool Kit Costout).<sup>7</sup>

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<sup>7</sup> <https://www.cbcse.org/costout>

## 5 Benefits

This chapter adds to the review from Karoly (2008) with the past decade's cost-benefit analyses identified in the literature search (Chapter 3).

Karoly (2008) assessed the state-of-the-art of measurement and use of shadow prices in cost-benefit analyses of social programmes. The review is based on 39 social programmes<sup>8</sup>: 10 studies evaluated early childhood programmes, whereas the remaining studies evaluated primary and secondary education or youth interventions. However, even fewer of the studies included a cost-benefit analysis. Among the 10 early childhood programmes evaluated, three studies follow children to early adulthood, four studies followed the children to at least age 15, two studies reported only short-term outcomes, and the last study included no cost-benefit analysis (Karoly 2008: p. xii). Karoly (2008) concludes that the literature lacks standards for monetisation of benefits and shadow prices. Karoly (2008) emphasises that many important benefits (meaning outcomes that showed a significant improvement in the original impact evaluation) are rarely, if ever, monetised. Furthermore, Karoly (2008) also concludes that in the cases where outcomes are valued by shadow prices the shadow prices do not consistently capture the full range of societal benefits or costs (for example, in not capturing spill-over effects or equilibrium effects). Moreover, even when there is a well-established literature for valuing outcomes, the use of shadow prices is not consistent across studies of social programmes (for example, valuation of crime). Finally, the uncertainty associated with projections of future outcomes based on early outcomes is also rarely discussed.

We start by reviewing the general framework for classifications of benefits and estimation (Sections 5.1-5.3), and then we review the recent literature and methods applied (Section 5.4). The aim is to describe best practice in studies published over the past decade.

### 5.1 Benefits from early childhood programmes

We subdivide benefits of early childhood programmes according to whether they are:

- Observable or future benefits
- Monetary or non-monetary benefits.

This subdivision is illustrated in Figure 5.1, including examples of the four resulting classifications of benefits.

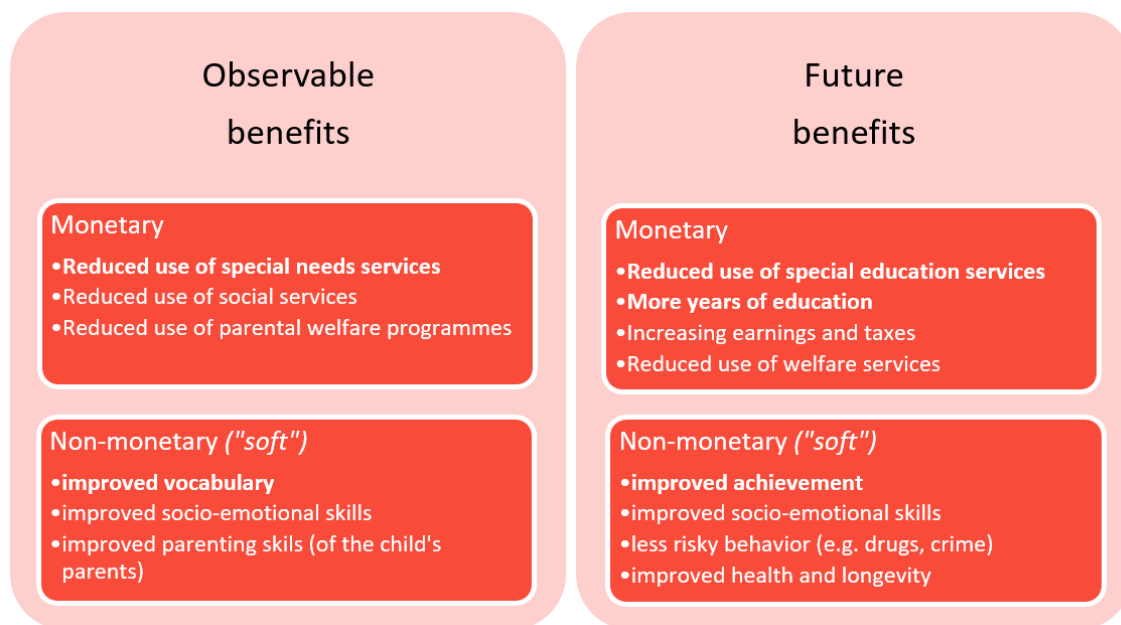
First, we distinguish between observable and future benefits. Observable benefits are typically those outcomes measured at the end of or shortly after the intervention. For example, children's language score is a typical outcome, if the aim of the intervention is to increase children's vocabulary. Future benefits are outcomes expected to appear later in the children's life. In the example with the intervention to increase children's vocabulary, future benefits may be improved reading skills through which the child may obtain more schooling and a healthier life. For most evaluations of childhood interventions, the sample of participating children are not yet old enough for the researchers to observe or measure all these potential benefits. The challenges, then, are to

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<sup>8</sup> The review is based on a literature search of evaluations of social programmes from the following organisations: The Blueprints for Violence Prevention Project at The University of Colorado at Boulder, RAND'S Promising Practices Network and the Coalition for Evidence-Based Policy.

hypothesise, and predict which of the observable outcomes may translate into future benefits and determine how to estimate the size of these future benefits.

**Figure 5.1** Benefits



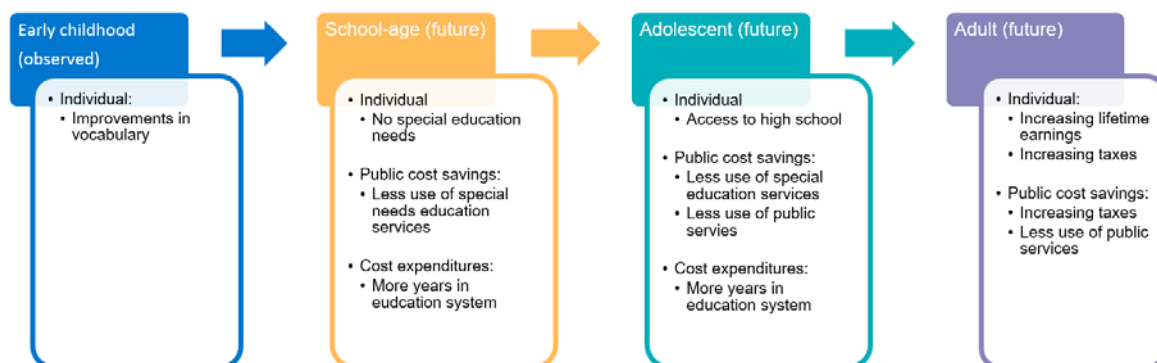
Note: The figure shows how we classify benefits as observable or future benefits. Both types of benefits are further subdivided into monetary and non-monetary benefits. The figure merely provides examples of benefits and is not exhaustive.

Second, we subdivide observable and future benefits into monetary and non-monetary benefits. Monetary benefits are outcomes that are naturally expressed in terms of a monetary value (dollar values). In most cases, the only benefits available to the researchers are the intervention's impact on children's short-term outcomes, such as scores from a reading test or other assessment instruments. These are also often what we categorise as "soft outcomes" – outcomes that cannot readily be monetarised.

As an example, we consider an early childhood programme that improves children's vocabulary. Improvements in vocabulary may improve reading skills and reduce the need for special needs services in school. Improved reading skills is a non-monetary outcome, since we cannot easily attach a dollar amount for each improved score on reading skills. Reduced need for special education services in school, on the other hand, can be given a monetary shadow price, since we can convert it to a dollar amount for savings in the education system (e.g. special teacher payments) for each point reduction in use of services (e.g. hours per week with a special teacher). Figure 5.2 illustrates this example. The figure shows the potential benefits for the individual and society from observed impacts in early childhood to future benefits in school-age, adolescence and adulthood.



**Figure 5.2** Illustration: Individual and societal benefits from early childhood programmes

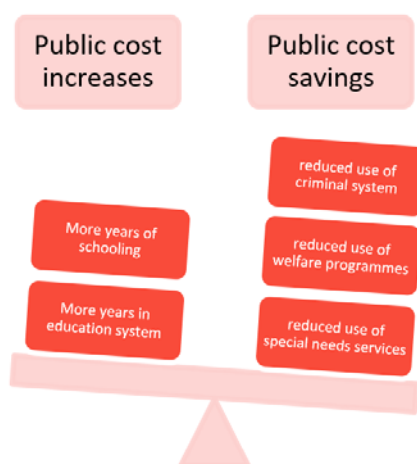


Note: Public services may include welfare, health care, housing, social services and crime prevention. The list of benefits is not exhaustive. For example, criminal behaviour (during school-age and adolescence) and crime (in adulthood) are not included.

### Benefits in terms of public costs savings

We continue to consider benefits in terms of reduced need for special education in school (see the example above). For society, this yields public cost-savings in the education system and thus counts positively in the net benefit of the programme. However, when children do better in school the likelihood that they obtain more years of schooling (e.g. enter and complete high school) must also be included and monetised. For the individual, obtaining more schooling increases lifetime earnings and taxes. For society, more schooling increases public spending on mainstream education. Figure 5.3 illustrates this with an example of public cost increases and public cost-savings from the same programme.

**Figure 5.3** Illustration: Benefits to the public



Note: This figure illustrates how benefits can both increase and reduce public costs when individuals do better in school, as a result of public investment in early childhood.

### Disaggregation on stakeholders

As the above examples illustrate, cost-benefit analysis also requires consideration of how costs and benefits are distributed among stakeholders.

For instance, cost-benefit estimates can be made separately for individual benefits and societal benefits. Additional educational attainment and lifetime earnings are common examples of individual benefits, while reductions in public spending on education, crime and the health system are typically considered public benefits. It is often the case that the benefits do not accrue to different stakeholders in proportion to their costs. Thus, an early education programme can have a very favourable overall benefit-cost ratio but an unfavourable one when only the costs and benefits to, for instance, the local state budget are considered.

To get a full picture of the aggregate costs and benefits of a public intervention, we recommend including and reporting all the costs and benefits for the individual (the programme participants), the government (tax payers) and society. A thorough cost-benefit analysis should not just report the *total* cost and benefits, but also report them at the disaggregated level to illustrate the costs and benefits from each perspective (i.e. the perspective of the individual, tax payer and society).

We now move on to estimation of primary impacts (Section 5.2) followed by estimation and monetisation of other benefits (Section 5.3).

## 5.2 Impact estimation (primary impacts)

To be able to monetise the impact of an early childhood intervention, it is crucial that the impact estimate is reliable and valid. A large body of literature discusses estimation of programme impacts, and since this is not the focus of the present review we merely provide a brief summary of best practice.

Impact estimates should be obtained from causal identification using experimental or quasi-experimental designs. Casual identification may arise from random comparison groups from a randomised controlled trial (RCT) (e.g. Belfield et al. 2006; Heckman et al. 2010; Campbell et al. 2014; Andersen et al. 2018 (RCT in Denmark); Doyle et al. 2013 (RCT in Ireland)) or non-random comparison groups in a quasi-experimental design (see e.g. Reynolds et al. 2011 or 2011b).

After obtaining a causal estimate, the point estimate can be multiplied by some monetary unit to obtain the monetary benefit. If the study is not able to identify the causal treatment effect of the intervention, we cannot conclude anything certain about effects in the short, medium or long run. Furthermore, if the study or sample has been compromised (e.g. due to imbalances in the randomisation result or attrition from the study) it may be necessary to adjust the primary impact estimates before proceeding to extrapolations and monetisation.

Three approaches are identified in the field:

- Impact estimates from the original impact evaluation are used directly and monetised and/or extrapolated to future benefits.
- Impact estimates are re-estimated using original data and then monetised and/or extrapolated to future benefits. This may be relevant if, for instance, concerns about the initial randomisation are raised, newer estimation techniques are available, or if the researcher wants to investigate other potential outcomes than those initially studied. For example, Heckman et al. (2010) adjust the initially estimated treatment effects for compromised randomisation and small sample bias before monetising the effects.
- Long-term impacts are estimated using new follow-up data. This is possible whenever data is available for assessing other outcomes or measuring outcomes at later stages in

childhood. Then, the impacts can be estimated for the new set of outcomes (using the original estimation method or an adjusted version), and these impacts can be monetised.

Although an early childhood programme is evaluated using a solid research design, such as the RCT, the evaluator often faces a number of implementation and methodological issues that potentially bias the results. This includes bias from attrition from the programme or missing one or more data collections, small samples and multiple hypotheses testing. The latter is a particular concern in long-term follow-ups, which typically consider a large set of exploratory outcomes. Below, we highlight a number of solid impact evaluations that take these issues into account.

To account for uncertainty in general, papers use bootstrapping of standard errors (Heckman et al. (2010); Doyle et al. 2013), Jackknife repeated simulations (Zerbe et al. 2009) or Monte Carlo simulations of point estimates and standard errors (Vining and Weimer 2009; 2010). We discuss uncertainty further in Chapter 8.

To account for small sample sizes, it is best practice to use bootstrapped standard errors. In addition, Campbell et al. (2014) accounts for small sample sizes using a block permutation test and reports blocked p-values (one-sided). Heckman et al. (2010) also proposes a permutation test combined with a stepdown procedure to assess the number of significant outcomes in a block of similar outcomes. We recommend reading Doyle et al. (2013) for a new application following the standards set in Heckman et al. (2010). Doyle et al. (2013) evaluate the Preparing for Life intervention in Ireland and correct impact estimates and standard errors for small sample sizes and multiple outcomes tested.

Multiple tests of outcomes and hypotheses increase the “false discovery rate” of treatment effects. To account for multiple hypotheses testing, the recommend practice is to use a stepdown procedure that allows testing for the joint significance of a set of outcomes at the same time (e.g. five different health measures, which would be called a “block” of child health outcomes). For example, stepdown procedures from Romano and Wolf (2005) (see review in Romano, Shaikh and Wolf 2010), who have developed different procedures and also provide Stata programs. These are applied in Doyle et al. (2013), Campbell et al. (2014) and Andersen et al. (2018). Campbell et al. (2014) report the p-values obtained from the multiple hypotheses stepdown procedure very well in their paper. In the background reports of the Preparing for Life Programme (Doyle et al. 2011), all tables are also highly transparent, as both ordinary and adjusted p-values are reported for each block of outcomes.

Attrition from the programme or separate data collections is a concern if it creates an imbalance in group members across the intervention groups and invalidates the randomisation. To investigate and analyse whether attrition biases the sample, see the Handbook of Field Experiments by Banerjee and Duflo (2017). To account for non-random attrition from follow-up data (i.e. missing data), studies use different imputation techniques, bounding of the treatment effects, trimming of the sample to balance the outcome distribution or apply inverse probability weighting. Using imputation techniques, one may replace (impute) missing values on outcomes with values assumed to reflect the outcomes of the missing persons (e.g. Andersen et al. 2018). Bounds analyses test different assumptions on the treatment effect for the missing persons (Horowitz and Manski 2000). By trimming the sample, one tries to create a balanced outcome sample by removing the part of the sample in which either the control or the treated groups are less likely to have an outcome (Lee 2009). Using inverse probability weighting, the observations are weighted to obtain a more balanced sample. One approach to obtaining weights is to use a logit model to estimate the probability of non-missing outcome (e.g. completing a questionnaire) after controlling for baseline characteristics (Doyle et al. 2013) or combinations of the characteristics that revealed imbalance across attriters and non-attriters (Campbell et al. 2014; Andersen et al. 2018).

Campbell et al. (2014) very clearly reports one table containing all of the above: correction for uncertainty, attrition, small sample bias and multiple hypotheses tested.

### 5.3 Benefit estimation (monetary values)

As illustrated in Figure 2.1 in Chapter 2, a number of steps are involved in the estimation of the costs and benefits of a programme. To estimate the benefits of an early childhood programme, we need to:

1. Identify all potential/relevant benefits
2. Estimate the benefits
3. Monetise the estimated benefits.

To identify relevant benefits, we may examine theory or findings from previous literature. Theory formulates potential effects, for example using a causal model of expected effects of a specific programme. The original impact evaluation may also point towards potential benefits in the short and long term, or provide evidence supporting the mechanisms of an intervention to point toward other benefits that can reasonably be expected in the long term. For example, if an intervention improves children's test scores through improved self-regulation it may seem reasonable to include second order benefits in the form of reduced criminal activity later in life (see discussion in Reynolds and Temple 2007).

When estimating the potential benefits, a number of methodological challenges arise. Benefits that are observable are estimated using common estimation techniques (depending on the experimental design). Future benefits that are not yet observable need to be predicted, e.g. through extrapolation out of the sample. We elaborate on these approaches below.

After obtaining estimates on potential benefits, we need to attach an economic value to the estimated benefits. We convert the estimated benefits into some monetary value (using market or shadow prices). This is done by multiplying by the market price or, if that is not available, a shadow price that captures the economic value and represents what the society is willing to pay for that outcome.

The following sections describe common approaches to monetising observable and future benefits, respectively.

#### 5.3.1 Monetisation of observable benefits (childhood)

Outcome measures in impact evaluations of early childhood programmes typically consider the child's behaviour and development of skills. These are not readily valued in monetary terms and are thus considered 'soft' benefits. Other outcomes may include parenting skills, mental health, child abuse etc., which are also difficult to give a monetary value.

Karoly (2008, 2012) shows a general lack of standardisation regarding how to assess and monetise these outcomes. This is particularly a challenge for cognitive, mental health and family outcomes (Karoly 2008). One reason for this is that for different early childhood interventions many different sets of outcomes are explored, as well different time horizons, which means that it is not possible to value the same set of observed outcomes or to make projections for those outcomes over the same future horizon across different childhood interventions.

The recommend approach is to find shadow prices for improvements in childhood benefits. Different methods may be applied, for example using cost-savings on public services as the monetary value for childhood benefits. This approach is mainly developed for educational childhood outcomes. For example the public cost-savings on special education when children, as a result of early childhood programmes, are less in need of special education services, see the example in Figure 5.2.

Belfield et al. (2015) have sketched a framework for cost-benefit analysis for interventions aimed at improving social and emotional learning.<sup>9</sup> They suggest at set of common shadow prices for observable measures of socio-emotional learnings. The most successful is their suggestion for calculation of shadow prices for children's aggression (ADHD symptoms), a measure that they are able to assess and monetise in five out of six of the interventions in their report. They do, however, conclude that the framework is far from standardised and that more research is needed to develop appropriate shadow prices.

In Chapter 6, we present empirical applications for different benefit domains separately.

### 5.3.2 Monetisation of future benefits (adult)

In order to make solid CBA for early childhood interventions, potential future benefits in adulthood should be included. Examples of future benefits that are often unobserved at the time of evaluation are educational attainment and labour market outcomes.

Even if this type of benefits are relatively easy to monetarise, it is a challenge that these outcomes are rarely observed in the available data period. The methodological challenge is thus to predict, or extrapolate, the sample children's future outcomes.

Two main challenges arise when projecting childhood outcomes to adulthood outcomes. Firstly, which (potential) benefits to include in the medium and long term, and secondly, how to predict these future benefits, e.g. by extrapolation out of the sample. For the second question, it becomes crucial how to determine the economic value of non-monetary and non-market outcomes by either intra- or extrapolated effect sizes to monetary outcomes. Intrapolation techniques are used to predict within-sample intermediate outcomes (e.g. educational attainment), and extrapolation is used to predict out-of-sample "links" to future outcomes (e.g. the link between educational attainment and earnings). We return to missing data and imputation techniques in Section 5.5.

One approach is to establish synthetic links to extrapolate the effects of outcomes beyond the last observation period. To accomplish this, several studies (see e.g. Heckman et al. (2010)) use a reference group consisting of individuals with similar features that have been observed for the relevant ages. Using this reference group we may establish links between intervention outcomes and important economic or social outcomes. Estimates on links between childhood outcomes and adult outcome may be obtained from existing evidence or estimated on auxiliary microdata (for example from historical longitudinal data or registry data).

A full accounting of potential benefits would require projecting outcomes from participation in early childhood education into the future, beyond the point of the last data follow-up. To do this, we need to make assumptions about:

- The causal relationship through time (i.e. pathway from impacts in early childhood to adulthood)

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<sup>9</sup> CBA was performed for the following interventions: 4Rs, Positive Action, Life skills training, Second step, Responsive classroom, and Social and Emotional Training. They were all tested in the US, except the last one which is Swedish.

- Spill-over effects to other future benefits (i.e. from future impacts on earnings and to criminal behaviour)
- Spill-over effects to other individuals (e.g. to the participants' parents' labour market attachment or siblings' development).

However, Karoly (2008) concludes that the literature lacks standards for these approaches. Karoly (2008) shows that in the cases where outcomes are valued by shadow prices, the shadow prices do not consistently capture the full range of societal benefits or costs (for example, in not capturing spill-over effects or equilibrium effects). Moreover, even when there is a well-established literature for valuing future outcomes, the use of shadow prices is not consistent across studies of social programmes (for example, valuation of crime). Finally, she showed that the uncertainty associated with projections of future outcomes based on early outcomes were rarely discussed.

## 5.4 Review of the benefit estimation methods applied in the past decade's CBAs of early childhood programmes

Below we will review the benefit estimation methods applied in the past decade's CBAs of early childhood interventions.

### 5.4.1 Included studies

The systematic literature search identified 15 cost-benefit analyses published since 2008 (Chapter 3). This may seem like a low number, but recall that we only include studies providing a full cost-benefit analysis with a description of benefits, costs and CB ratios. Evidence on evaluations of early childhood programmes (without monetisation of benefits) is greater, but is excluded from this review. The number of cost-benefit analyses found here is comparable to the number of studies included in Karoly (2008). Karoly (2008) is based on 39 social programmes<sup>10</sup>: 10 of these studies evaluated early childhood programmes, whereas the remaining studies evaluated primary and secondary education or youth interventions. However, even fewer of the studies included a cost-benefit analysis. Of the 10 early childhood programmes evaluated, three studies follow children to early adulthood, four studies follow the children to at least age 15, two studies include only short-term outcomes and the last study includes no cost-benefit analysis (Karoly 2008: p. xii).

Table 5.1 reports information about the 15 costs-benefit analyses that we include in our review, with a special focus on the included benefit domains. The table reports the programmes' name, age at intervention start, age at the last observed data collection, benefit domains included and whether the study applies projection to future ages.

In general, the interventions start around ages 3-4 but there are large differences in how long the researchers are able to collect data on outcomes. Some (newer) programmes only have a few years of follow-up. Other (older) programmes are now able to follow the programme participants until they are in their 40's.

The table also shows that 11 out of the 15 reviewed cost-benefit analyses observe or project adult outcomes. This is more than in the studies reviewed in Karoly (2008) and thus should provide a source for new insights on methods.

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<sup>10</sup> The review is based on a literature search for evaluations of social programmes from the following organisations: The Blueprints for Violence Prevention Project at The University of Colorado at Boulder, RAND'S Promising Practices Network and the Coalition for Evidence-Based Policy.

**Table 5.1** Included cost-benefit analyses in review

Study / Programme	Age (programme start)	Age (Observed)	Age (Projected)	Benefit domain								Outcomes		
				Cognitive	Behaviour	Education	Economic	Health	Family	Crime	Soc. ser.	Observed and monetised	Projected and monetised	
Kline & Walters 2016 / Head start	Birth	7	Adult	O	O		P		O				<ul style="list-style-type: none"> <li>Cognitive test scores</li> </ul>	<ul style="list-style-type: none"> <li>Lifetime earnings</li> <li>Taxes</li> <li>Fiscal externalities</li> </ul>
Bartik et al. 2016 / Tulsa Pre-K program	4	Until age 15 (grades 1-9)	Adult (18-79)			O	P		O	P			<ul style="list-style-type: none"> <li>Grade retention in K1-9</li> <li>Test scores</li> <li>Parents' earnings</li> </ul>	<ul style="list-style-type: none"> <li>Lifetime earnings profiles</li> <li>Lifetime crime profiles</li> </ul>
Belfield et al. 2015 / 4Rs Program; Second Step; Life Skills Training; Responsive Classroom; Positive Action; Social and Emotional Training	Varies (3-16)	1-5 years after intervention	Varies (age 30)	O	O	O	P	O	O	O	O	O	<ul style="list-style-type: none"> <li>Attention skills</li> <li>ADHD symptoms</li> <li>Conduct problems</li> <li>Social competences</li> <li>Aggression</li> <li>Bullying</li> <li>Test scores</li> <li>Special education</li> <li>Grade retention</li> <li>Mental health (depression, anxiety)</li> <li>Substance abuse (drugs, alcohol, smoking)</li> <li>Delinquency, violence</li> <li>Sexual risk behaviour</li> </ul>	<ul style="list-style-type: none"> <li>Cost-of-illness approach</li> <li>Earnings</li> <li>Labour market gains</li> </ul> <p>Cost-savings on:</p> <ul style="list-style-type: none"> <li>Education</li> <li>Employment</li> <li>Health</li> <li>Crime</li> </ul>
Heckman et al. 2010 / Perry Preschool Program	3	15, 19, 27, and 40	65	O		M	O	O		O	O	O	<ul style="list-style-type: none"> <li>Child's IQ at age 3 (not monetised)</li> <li>K-12 education and GED</li> <li>Special education</li> <li>Vocational training</li> <li>College</li> <li>Earnings</li> <li>Employment</li> <li>Welfare</li> <li>Criminal activity</li> </ul>	<ul style="list-style-type: none"> <li>Lifetime earnings</li> <li>Lifetime projection of cost of welfare</li> <li>Lifetime crime profiles</li> <li>Taxes and DWL</li> </ul>
Garcia et al. 2016 / Carolina Abecedarian Program (ABC) and Carolina Approach to Responsive Education (CARE)	Birth	Yearly until age 8  Follow-up: Ages 12, 15, 21 and 30s	21-67	O	O	O	O	O	O	O	O	O	<p>Parents:</p> <ul style="list-style-type: none"> <li>Income and labour supply</li> </ul> <p>Child:</p> <ul style="list-style-type: none"> <li>K-12 education costs</li> <li>Education attainment</li> <li>Health</li> <li>Hospitalisations</li> <li>Criminal activity</li> <li>Income and employment</li> <li>Transfer income</li> </ul>	<ul style="list-style-type: none"> <li>Lifetime earnings</li> <li>Lifetime crime profiles</li> <li>Lifetime health (heart disease, diabetes etc.)</li> </ul>
Bartik (2013) / Kalamazoo County Ready 4s program	3	5	Adult	O			P						<ul style="list-style-type: none"> <li>Test scores: letters, vocabulary and pre-maths</li> </ul>	<ul style="list-style-type: none"> <li>Earnings</li> </ul>
Reynolds et al. 2011 / Chicago CPC	3-6	Until age 26	65			O	O	O		O	O	O	<ul style="list-style-type: none"> <li>Special education</li> <li>Grade retention</li> <li>Educational attainment</li> <li>Criminal activity</li> <li>Child maltreatment system costs</li> <li>Health (depression, substance abuse)</li> </ul>	<ul style="list-style-type: none"> <li>Education costs</li> <li>Lifetime earnings</li> <li>Taxes</li> <li>Criminal justice system costs</li> <li>Child maltreatment private costs</li> <li>Adult depression costs</li> <li>Mortality costs of substance abuse</li> </ul>
White et al. 2010 /	3	Until age 27	44							O	O	O	<ul style="list-style-type: none"> <li>Juvenile delinquency (ages 10-18)</li> <li>Adult criminal activity (ages 19-27)</li> </ul>	<ul style="list-style-type: none"> <li>Adult criminal activity after age 27</li> </ul>

Chicago CPC Preschool																			
O'Neill et al. 2013 / The Incredible Years Parenting Programme	3-7	3-7	30	O	P	P	O	P	O	M								<ul style="list-style-type: none"> <li>• Eyberg intensity score (conduct problems)</li> <li>• Use of health services</li> <li>• Use of social services</li> </ul>	<ul style="list-style-type: none"> <li>• Special education costs</li> <li>• Unemployment cost (welfare and loss in taxes)</li> <li>• Crime system costs (imprisonment)</li> </ul>
Zerbe et al. 2009 / The Casey Family Programs	14-18	24	Not projected	O	O	P	O	O	M									<ul style="list-style-type: none"> <li>• Educational attainment</li> <li>• Employment</li> <li>• Health (physical or mental disorders)</li> </ul>	<ul style="list-style-type: none"> <li>• Lifetime earnings</li> <li>• Lifetime health</li> <li>• Lifetime family finances</li> </ul>
Tiba & Furak-Pop 2012 / CBT Program	0-18	0-18	Not projected															<ul style="list-style-type: none"> <li>• Number of child separations (child protective service costs)</li> </ul>	None
Lynch et al. 2014 / Multidimensional Treatment Foster Care for Preschoolers	3-5	5-7	Not projected	O														<ul style="list-style-type: none"> <li>• Permanent placement</li> </ul>	None
Bartik et al. 2012 / Tulsa Pre-K Program	4	5	22-66	O			P	P	P									<ul style="list-style-type: none"> <li>• Test scores: letters, vocabulary and pre-math</li> </ul>	<ul style="list-style-type: none"> <li>• Childs' earnings</li> <li>• Parents' earnings</li> </ul>
Schweinhart 2013 / Perry Preschool Program	Birth	40	40	O	O	O	O											<ul style="list-style-type: none"> <li>• Education costs</li> <li>• Welfare costs</li> <li>• Earnings and taxes</li> </ul>	<ul style="list-style-type: none"> <li>• Crime</li> </ul>
van Huizen et al. 2016 / Universal Preschool Educational Reform in Spain	3	15	16-70			O	P		P									<ul style="list-style-type: none"> <li>• Maternal employment</li> <li>• Grade retention</li> <li>• Test scores (PISA)</li> </ul>	<ul style="list-style-type: none"> <li>• Mother's earnings</li> <li>• Child earnings</li> <li>• Child employment</li> </ul>

General note: This table summarises information about benefits observed and valued in the reviewed cost-benefit analyses. Note that some outcomes may merely be observed (O) in data but not monetised (M) and are thus not reported in the last two columns.

Note: O: Observed; M: Monetised; P: Projected.

Test scores in preschool are categorised in the cognitive domain, whereas test scores and GPA in K-12 education are categorised in the education domain. Soc. ser.: Social services such as child protective services.

## 5.4.2 Benefit domains

We follow the operationalisation in Karoly (2008; 2012), which reviewed and identified six benefit-domains of outcomes with favourable impacts from early childhood interventions. The domains are:

1. Cognitive development (e.g. IQ, language)
2. Behavioural/Emotional development (e.g. socio-emotional skills, self-regulation and non-cognitive skills)
3. Education (e.g. school readiness, test scores, retention, special education and educational attainment)
4. Economic (earnings, employment and social welfare)
5. Health (e.g. abuse and neglect, mental health and health care usage)
6. Crime and substance abuse (e.g. criminal activity, and use of alcohol and drugs).

Benefits in the domains of cognitive development, behavioural/emotional development and education are typically evaluated as the primary programme outcome of interest. However, due to



the lack of common recommendations on how to translate these into monetarised benefits, these were rarely included in cost-benefit analyses (Karoly 2008; 2012).

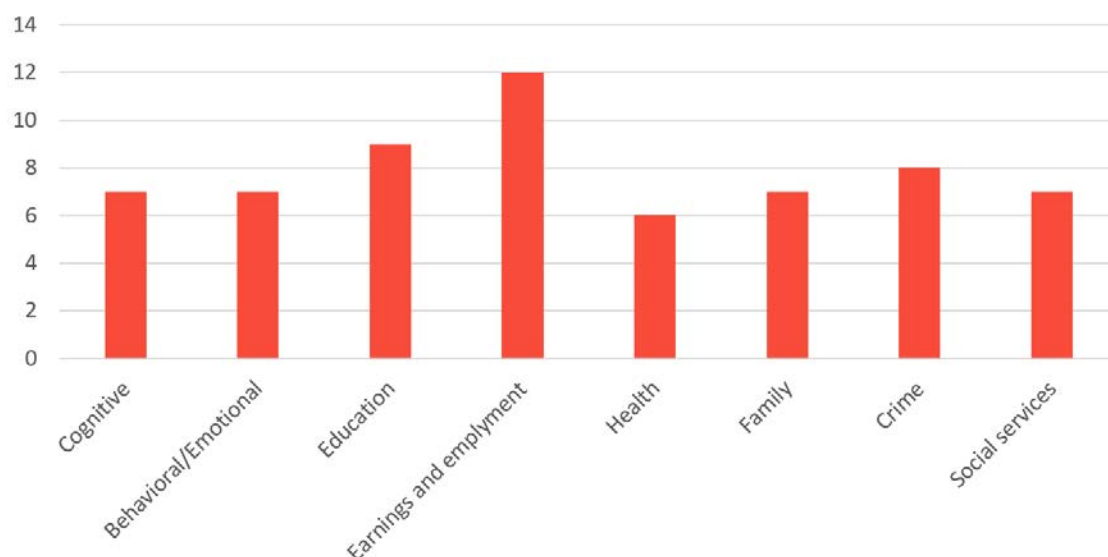
In addition, we add the domains family and social services, which are of particular interest in Scandinavian/Nordic welfare states. Outcomes considering child abuse and neglect are moved to social services.

7. Family (e.g. parents' outcomes)
8. Social services (e.g. child protective services, child abuse and neglect, and housing).

Karoly (2008) found that, in general, the range of benefit domains in early childhood intervention programmes is broader than for other intervention fields, such as education intervention programmes and youth development programmes. Karoly (2008; Table 2.5) concludes that the most commonly occurring outcomes for children and youths are in the domains of behavioural/emotional outcomes, which were included in five studies, cognitive outcomes, which were included in six studies and education outcomes, which were included in six studies out of 10 studies on social programmes. For adults, the outcomes most frequently fell within the domains of family functioning, included in four studies, and economic outcomes, also included in four studies. If the outcomes for children and adults are combined, the health domain is also among those most often used, with five studies including such outcomes.

We map our literature (15 cost-benefit analyses) according to the eight benefit domains. The domains are cognitive outcomes, behavioural/emotional outcomes, education outcomes, earnings and employment outcomes, health outcomes, family outcomes, crime outcomes and social outcomes. The result is shown in Figure 5.4. The figure shows that 12 studies include economic outcomes (earnings and employment), nine studies include educational outcomes, and eight studies include crime outcomes. This is in line with Karoly (2008), who also found these domains to be among those most often included.

**Figure 5.4** Benefit domains assessed in reviewed cost-benefit analyses



General note: Total of 15 studies with a cost-benefit analyses. The number reflects either observed (O), monetised (M) and/or projected (P) benefit domains; see Table 5.2.

Fewer cost-benefit analyses assess benefits in the domains of health (six studies), family (seven studies) and cognitive development (seven studies), and only seven studies observe behavioural/emotional outcomes. The fact that less than half of the cost-benefit analyses published between 2008-2017 include some of these domains emphasises that a standardised framework regarding which benefits to include in cost-benefit analyses as a minimum is still far from established.

Table 5.1 also reported whether the outcomes are observed in data (O), monetised (M) or projected (P). From the table we see that seven studies observe (O) cognitive outcomes measured in childhood (e.g. vocabulary test in preschool), but of these only four studies observe and monetise (O+M) the outcomes. For behavioural/emotional outcomes, the result is similar: seven cost-benefit analyses have access to observed outcomes of behavioural/emotional development but only two cost-benefit analyses monetise these. For some studies, this is because no significant impact was estimated on the cognitive outcomes and thus there was no cause to monetise these.

Table 5.2 summarises the age at last follow-up in the cost-benefit analyses and whether the studies include lifetime projection of future benefits. The table shows that the availability of data varies. Some studies only observe the children until ages 5-7, whereas other studies observe outcomes until the children are in their 40s. Lifetime projections are applied in 11 cost-benefit analyses, also in studies that only observe children until ages 5-7.

**Table 5.2** Cost-benefit studies: Age at last follow-up

Age at last follow-up	No. studies	No. of studies adding lifetime projections of future benefits
Age 0	1	0
Age 5 (preschool)	3	2
Age 5-7 (school)	4	2
Age 15	4	1
Age 18	2	0
Age 20s	4	3
Age 30s	1	1
Age 40s	3	2
Total	-	11

Note: This table categorises studies by participants' age at the last observed follow-up data. In total there were 15 cost-benefit analyses.

Our review thus shows a lack of consensus on included and valued outcomes (except lifetime earnings). There are still very few soft outcomes that are included and valued. For childhood outcomes, the most common observed outcomes are test scores, special education and grade retention.

We review in detail the used shadow prices for childhood and adult outcomes in Chapter 6 and 7, respectively.

### 5.4.3 General methodological choices

In general, the results of cost-benefit analyses of early childhood programmes are sensitive to various methodological choices and assumptions, such as the time horizon, discount rate and how uncertainty is incorporated. Transparency in reporting of cost-benefits analyses is therefore crucial. Tables 5.3 and 5.4 summarise the standards of reporting and discussion in the reviewed cost-benefit analyses.

Table 5.3 shows that 15 studies report either an internal rate of return or a cost-benefit rate, the cost-benefit ratio being reported in 11 of these studies.

**Table 5.3** Cost-benefit studies: Reporting

Reported in publication	Total
Internal rate of return	7
Cost-benefit rate	11
Internal rate of return or cost-benefit rate	15

Note: Total of 15 studies with a cost-benefit analyses

Table 5.4 shows that 11 out of 15 cost-benefit analyses discuss discounting and only eight studies discuss uncertainty. In addition, seven studies discuss methods for imputation and/or extrapolation techniques. This reveals that we only have a subset of studies for the remaining discussions of methodological development. Hence, there is a general lack of standardised and transparent reporting in cost-benefit analyses.

**Table 5.4** Cost-benefit studies: Methods applied

Included in publication	Yes
Discussion of discounting	11
Discussion of uncertainty/standard errors	8
Discussion of methods for missing data/imputation methods	7
Out-of-sample extrapolation to future outcomes	7

Note: Total of 15 studies with a cost-benefit analysis.

#### 5.4.4 Time horizon and discounting

Depending on the time horizon (e.g. 1 year, 10 years or a life time) for benefits included, discounting to common year (and age of the participant) becomes relevant. Table 5.5 shows that four studies project benefits to age 30s and five studies project to age 60s (lifetime). Four out of our 15 cost-benefit analyses do not apply projections of future benefits.

**Table 5.5** Cost-benefit studies: Time horizon

Project benefits to	No. of studies	Include lifetime projection
Age 60s	5	5
Age 40s	5	4
Age 30s	4	3
No projections	4	1

Note: This table categorises studies by aggregated years of follow-up data included in the evaluation. Total of 15 cost-benefit analyses.

When costs and/or benefits accrue over multiple time periods, the dollar streams must be discounted to reflect the time value of money. It is common to use an annual real discount rate published by national authorities (e.g. the Ministry of Finance). In the reviewed cost-benefit analyses, the discount rate is generally 3%. In addition, it is common practice to test the sensitivity of the CB ratio to different discount rates (e.g. ranges from 0 to 7%) (see e.g. Heckman et al. 2010; Reynolds et al. 2011).

**Table 5.6** CBA discounting and standard errors

Study/ Programme name	CBA discount rate (%)	CBA discounts to Age	CBA reports standard errors?
Kline & Walters 2016/ Head start	3	3-4	Yes
Bartik et al. 2016/ Pre-K Tulsa	3	4	No
Belfield et al. 2015/ 4Rs; Second Step, Life Skills Training; and Responsive Classroom	3, 5	8-9	No
Heckman et al. 2010a/ Perry Preschool Program	0, 3, 5, 7	N.a.	Yes
Garcia et al. 2016/ The Life-cycle Benefits of an Influential Early Childhood Program	3	N.a.	Yes
Bartik 2013/ Kalamazoo County Ready 4s program (a pre-school program)	N.a.	N.a.	No
Reynolds et al. 2011/ Chicago CPC	3	3	Yes
White et al. 2010/ CPC Preschool	3	3	No
O'Neill et al. 2013/ The Incredible Years Parenting Programme	5	N.a.	Yes
Zerbe et al. 2009/ The Casey Family Programs	3	N.a.	Yes
Tiba & Furak-Pop 2012/ CBT Program	N.a.	N.a.	No
Lynch et al. 2014/ Multidimensional Treatment Foster Care for Preschoolers	N.a.	N.a.	No
Bartik et al. 2012/ The Tulsa Universal Pre-K Program	3	4	Yes
Schweinhart 2013/ Perry Preschool Program	3	N.a.	No
van Huizen et al. 2016/ Universal Preschool Educational Reform in Spain	3 Test range 0-7	3-11	Yes

Note: CBA reports on standard errors include reporting the standard errors on the CB ratio (few studies) or the standard errors on estimates of benefits and costs.

N.a.: Not available in text.

Table 5.6 summarises the time horizon and discount rates applied in the 15 cost-benefit analyses. The table shows that the applied discount rate is 3%, and varies from 0-7% in sensitivity tests.

One may also choose to discount future benefits (e.g. earnings) back to the age of the participating children when they entered the intervention. This allows for correct comparison of the programme's (future) benefits with the programme's cost when implemented (e.g. when the children are four years old), which is the policy-relevant comparison. Table 5.6 shows that half of the reviewed cost-benefit analyses discount back to age at intervention participation (recall Table 5.1), while the others do not report that information.

Bartik (2009) discusses discounting assumptions thoroughly and simulates cost-benefit ratios of the Abecedarian programme when applying various discounting assumptions and rates. We recommend this paper for a deeper methodological discussion.

#### 5.4.5 Missing data and imputation techniques

Data on the participating population may be missing, if participants missed one or more interviews/surveys or failed to answer one or more questions in the interview. Hence, although the participant sample is old enough for follow-up data to be collected they might still have missing outcomes. Different approaches to analyse and correct for attrition exist and are applied in various impact evaluations. In general, the same techniques could be applied in cost-benefit analyses to estimate the impact before attaching an economic value to the impact estimate.

Another concern is when some time periods are missing in the data collection. For example, if the researcher has collected age-21 data and age-40 data but wishes to intrapolate income data for each period in-between. Methods exist to impute values (e.g. linear interpolation) for each year between age 21 and age 40.

Missing data may be imputed by different imputation techniques. For a review, see McCurdy (2007).

For a state-of-the-art cost-benefit analysis discussion and testing of different imputation techniques, we recommend Heckman et al. (2010). Heckman et al. (2010) compares benefit-costs ratios after applying four different imputation techniques. Although they have collected data at age 40, some data will be missing if respondents either did not participate in the interview or skipped some of the questions (e.g. questions about income). Therefore, they impute missing values for periods prior to the age-40 interview. Heckman et al. (2010) use four different imputation procedures and compare the resulting estimates.

**Table 5.7** Imputation techniques

Imputation technique	Description	References
Simple piecewise linear interpolation	Based on weighted averages of the nearest observed data points around the missing point	Heckman et al. (2010; missing earnings); Belfield et al. (2006)
Cross-sectional regression imputation	Cross-sectional regression imputation using a cross-section earnings estimation from a similar sample (the NLSY79 black low-ability subsample). Two different earnings functions are tested: - Mincerian earnings function - Dynamic earnings functions using the method in Hause (1980)	Heckman et al. (2010; missing earnings)
Kernel matching method		Heckman et al. (2010; missing earnings)
Dynamic earnings functions using the method in Hause (1980)	To impute missing earnings, estimate dynamic earnings functions using the method by Hause (1980).	Heckman et al. (2010; missing earnings)
Multiple imputation	Multiple imputation (Little and Rubin 2002; Rubin 1987).  This method creates multiple complete data sets with plausible values for missing data based on observed values. Multiple imputation has been shown to outperform other missing data techniques (Sinharay, Stern and Russell 2001).  Using Stata ICE package.	Bartik et al. (2012)

Imputation technique	Description	References
Inverse probability weighting (IPW)	The selection of covariates for IPW is based on the lowest AIC among models including combinations of the covariates that revealed imbalance across attriters and non-attriters.	Campbell et al. (2014)
Inverse probability weighting (IPW)	Weights obtained from a logit model estimating the probability of non-missing outcome after controlling for baseline characteristics.	Doyle et al. (2013) Andersen et al. (2018)
No imputation	They discuss imputation but choose to only use complete cases (i.e. observations with no missing outcomes).	O'Neill et al. (2013)

Note: This table illustrates imputation techniques applied in the reviewed cost-benefit analyses.

## 6 Monetisation of childhood benefits

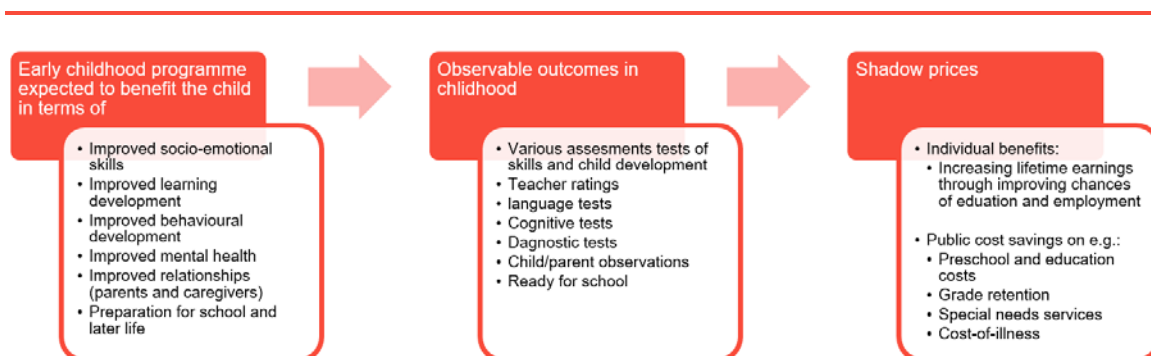
In this chapter, we consider benefits that are observable and measured in the programme evaluation or shortly after. These are often soft benefits with no market value, so it is necessary to consider potential shadow prices in order to attach an economic value to these benefits. In Section 6.1, we describe the general methodology and challenges. The following subsections describe applications for each benefit domain separately and can be read independently. We consider benefits in the domains of cognitive development, behavioural/emotional development and education.

### 6.1 General methodology and challenges

Children's primary benefits from early childhood interventions are typically characterised as development in areas that are difficult to measure and monetarise, typically "soft" outcomes such as cognitive or socio-emotional development. In the programme evaluation, these are typically measured using different assessment tests or child observation during the intervention or shortly after. However, as there is no common recommendation on how to translate these into monetarised benefits, these are rarely included in cost-benefit analyses (Karoly 2008; 2012). Our review of cost-benefit publications from the past decade confirms that this issue has not yet been resolved (see Chapter 4).

Figure 6.1 illustrates the idea of using shadow prices to value non-observable and non-monetary benefits of early childhood programmes. The three boxes in the figure illustrate examples of benefits that early childhood programmes aim to improve, how benefits may be observed and possible shadow prices to add a monetary value to the benefit. For example, an early childhood programme in preschool aims to improve children's socio-emotional skills (box 1). The evaluator used the SEAM assessment test to observe and compare children's socio-emotional skills before and after the intervention with those of the children in the control group (box 2). However, no monetary value exists to assess the improvements in SEAM scores. As a potential shadow price for improvements in SEAM, the cost-benefit analyst used the monetary benefit in terms of public cost savings instead (box 3).

**Figure 6.1** Illustration of shadow prices for childhood outcomes



Note: This figure illustrates examples of shadow prices for childhood outcome (the list is not exhaustive).

The figure also illustrates the main methodological challenges. Firstly, how to observe and measure outcomes in childhood. Secondly, how to add shadow prices to improvements in childhood outcomes, for example improved reading test scores or reductions in ADHD symptoms. The figure also illustrates a potential large and broad set of outcomes from early childhood programmes. An

additional challenge is to decide how many of the observed outcomes should be valued and included in the benefit calculation. There is a risk of double-counting future benefits, for instance, when the programme evaluation has shown effects on multiple cognitive or non-cognitive outcomes that are all expected to (jointly) influence future outcomes.

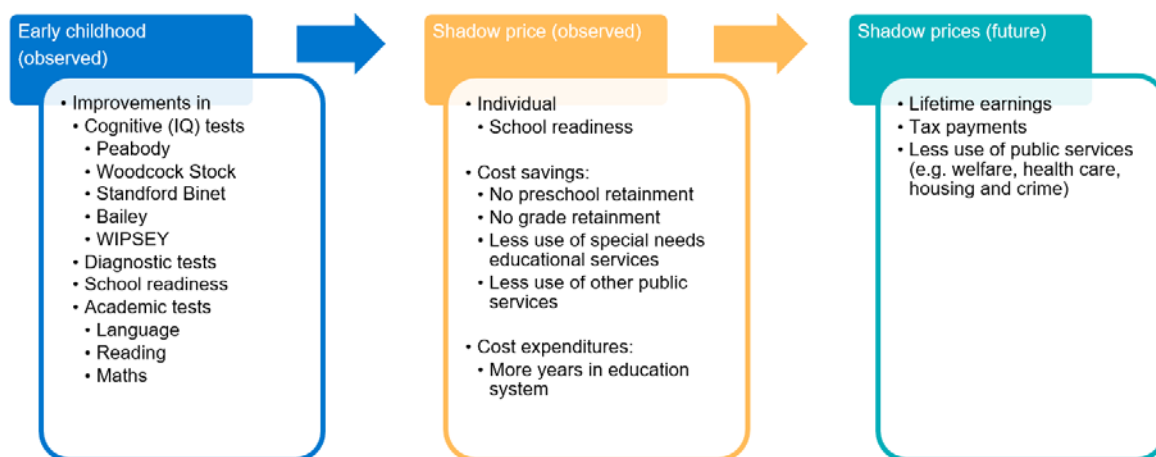
The following sections review applications and best practice for each benefit domain separately. We discuss the methodology and provides examples from our literature search.

## 6.2 Cognitive development

Early childhood programmes aim at improving children's cognitive development, e.g. in information processing and language. Improvements in children's cognitive development are expected to influence other observable outcomes, such as children's accumulation of further cognitive and non-cognitive skills, mental development and academic skills (such as reading or maths), as well as preparing the child for school generally (see e.g. Duncan and Magnuson 2013).

No direct market value for cognitive skills or development exists. The literature discusses different potential shadow prices for the economic value of cognitive skills. In the short term, development of cognitive skills prepare the child for school start at the compulsory school starting age. Thus, one shadow price for delayed cognitive development may be the cost of retaining the child one additional year in preschool compared to the costs of entering school. Other relevant shadow prices are the potential cost savings on special needs education in preschool or school, in psychiatric services (e.g. in-depth assessment of children with learning difficulties or a behavioural or mental diagnoses) and other public services. Future outcomes are usually accounted for by individuals obtaining education and earnings and public costs saving through reduced use of public services (education, health and welfare services). This is illustrated in Figure 6.2.

**Figure 6.2** Monetisation of cognitive outcomes





From the literature review, we identified the following cost-benefit analyses considering cognitive development:

- Kline et al. (2016) evaluating Head Start
- Belfield et al.(2015) evaluating the preschool programme Second Step (achievement test scores)
- Heckman et al. (2010)
- Bartik et al. (2012) evaluating a preschool programme in Tulsa
- Vining and Weimer (2010)
- Beatty (2009)
- Kilburn et al. (2008).

Kline et al. (2016) observe children's cognitive test scores as primary outcomes of the Head Start intervention. They use the Peabody and Woodcock Johnson tests to measure cognitive development and collect these one, two and three years after preschool enrolment. The last observations of the children in the data is when children they are about 7 years old and in grade 1. Thus, the authors need to extrapolate the impact of cognitive test scores to future outcomes in order to value the lifetime benefits of the intervention. As shadow price for improvements in cognitive test scores they use children's future earnings, meaning that they value the impact of the cognitive test score using the test score effect on children's after-tax lifetime earnings. They use estimates from previous studies on the relation between test scores and earnings and multiply these by their own impact estimates.

Heckman et al. (2010) measure children's cognitive development using the Child's Stanford-Binet IQ at age three. However, because they also collect follow-up data on children's outcomes when they have turned 40 (education, earnings and crime) they can estimate the direct effect on adult outcomes and do not need to value the children's cognitive test scores.

Bartik et al. (2012) estimates earnings benefits for children who participated in the Tulsa pre-K program. The interesting contribution of this paper is that earnings benefits are presented for three different income groups. As in Kline et al. (2016), they use the estimates of the relationship between test scores and earnings from Chetty et al. (2011). The authors provide a solid discussion of the validity of using extrapolation estimates from one study/intervention in another study/intervention and of the issues that may arise.

Belfield et al. (2015) mainly focus on shadow prices for social and emotional learnings. However, they do provide a few examples of potential shadow prices for cognitive outcomes. For cognitive outcomes where a related health problem is observed (for example ADHD), they suggest basing shadow prices on the current spending on these conditions through the health care system. For cognitive outcomes measured using achievement tests, they translate impacts on children's achievement (e.g. in reading and maths tests) to impacts on children's future labour market attachment and earnings. They use the association (from previous studies) between students' achievement and earnings to calculate lifetime earnings.

Kilburn et al. (2008), Beatty et al. (2009) and Vining and Weimer (2010) do not conduct cost-benefit analyses but discuss general frameworks for obtaining and including shadow prices for cognition and IQ in cost-benefit analyses of early childhood programmes. Vining and Weimer (2010) also provide a discussion of redistribution and opportunity costs.

For further reading on how to link test scores to future earnings, see empirical applications (not necessarily cost-benefit analyses) from:

- Chetty et al. (2011)
- Heckman, Pinto and Savelyev (2013)
- Chetty, Friedman and Rockoff (2014)
- Bartik, Gormley and Adelstein (2012)
- Aos et al. (2004).

### **Conclusion and research perspectives**

Cognitive development is rarely included and monetised in cost-benefit analyses. Several papers discuss the importance of including these outcomes in economic evaluations of early childhood interventions. It seems that two main approaches are generally suggested.

The first approach, and the most commonly applied, is to operationalise cognitive development using the development on achievement tests from preschool or schools (for example language, reading or maths tests). This allows the literature on the return to education to provide various estimates on the relationship between achievement test scores and individual earnings, which can be used to attach an economic value to test score impacts. The literature also provides guidance on how to construct different earning profiles for different educational groups.

The second approach is the cost-of-illness approach. By relating cognitive development to diagnoses and disabilities, it is possible to calculate how much society currently spends on various special needs groups, for example children with special needs due to delayed cognition, autism with/without cognitive delay, ADHD, learning difficulties etc.

The availability of more detailed registry data on children and use of public services allows for inclusion of more future benefits. The cost savings estimates could be expanded to include current spending on these conditions through not only the health care system (as proposed by Belfield et al. (2015)) but also the education system, social services (for child and parent) etc. With detailed background information on similar populations' registry data, it is also possible to obtain these cost savings estimates for all specific groups of children. One way to do this is to construct public service use profiles for groups of children with specific diagnoses or other operationalisation's of cognitive skills, e.g. if certain groups of children score better in different parts of achievement test distribution in school. This makes it possible to calculate the cost savings from moving children one SD up in the distribution.

## **6.3 Behaviour/emotional development**

The aim of early childhood programmes is to support and improve children's development of a broad set of skills. We consider children's social, emotional, personal and behavioural development broadly as "soft skills". The aim of this review is not to distinguish between different types of skills or personal traits, but rather to provide a general discussion of how these are measured and valued in cost-benefit analyses. For a discussion of distinction between children's interpersonal and intrapersonal skills and how these may be assessed and/or observed in evaluations, see Jones et al. (2015).

Social and behavioural development enhances the child's accumulation of cognitive and non-cognitive skills and is therefore important for preparing the child for school and adolescences. For

example, social competencies are central to taking part in the community, in the classroom and later in the workplace.

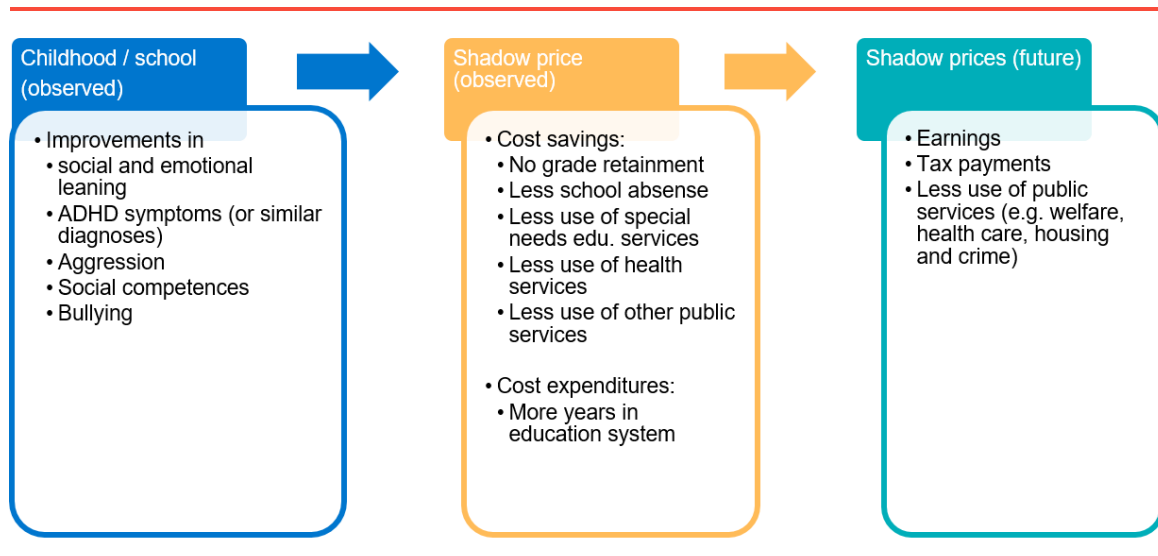
In an economic context (the human capital model), children’s soft skills are inputs that accumulate development of other skills and thereby benefit education and productivity (Kilburn et al. 2008; Beaty (2009); Jones et al. 2015). Social and emotional development relate to “soft skills” and personality traits that are shown to predict success in school, the labour market and in life generally (Heckman and Kautz 2012; Almlund et al.2011). Studies document positive correlations between soft skills and academic and economic success, health and criminal activity (Heckman and Kautz 2012; Almlund et al. 2011).

It is now also becoming widely recognised that social and behavioural learning in schools can be as important as or even more important than cognitive achievement gains in explaining important life outcomes (Almlund et al. 2011; Durlak et al. 2011; Heckman and Kautz 2012; Levin 2012).

Programme evaluations show that early childhood and education programmes can positively improve the development of cognitive and non-cognitive skills (Duncan and Magnuson 2013; Karoly 2016) and hence future economic and social outcomes. The emotional and behavioural skills, however, are less commonly considered in early childhood evaluations, in part because measurement is more challenging than for academic outcomes such as test scores (Belfield et al. 2015; Gormley, Newmark and Adelstein 2011).

In this section, we consider how to assess the economic values of these soft skills. Our literature review shows that although there is a broad consensus on the importance (and economic return) of improving these soft skills, very few studies are able to observe and value improvements in soft skills. This was illustrated in Chapter 3, where a large set of the results from the database search was excluded after full-text reading, as the studies merely discussed the importance of valuing improvements in children’s social and emotional skills without actually providing any valuations or calculations (e.g. Jones et al. 2015).

**Figure 6.3** Monetisation of behavioural/emotional outcomes



In the past decade of cost-benefit analyses, the following studies have assessed the economic value of emotional/behavioural benefits:

- Belfield et al. (2015) evaluating different interventions for socio-emotional development
- O'Neill et al. (2010, 2013) evaluating the Incredible Years Parenting Programme.

In a subset of the identified cost-benefit analyses, the evaluation includes outcomes on socioemotional development or behaviour, but as the outcomes are not significantly different from those of the control groups, authors do not include or monetise these in the cost-benefit analysis. For example, in a cost-benefit analysis of Head Start, parent and teacher-reported measures of children's behaviour are available, but these are not monetised because they are not significantly different from outcomes of the control groups (Kline et al. 2016).

**Table 6.1** Shadow prices for behaviour/emotional development

Benefit	Shadow price	Describe/shadow price	References
Aggression	Cost-savings on health services	Savings on health care expenditures for persons with conduct disorder (CD)	Belfield et al. (2015)
Bullying	The society's willingness to pay for a day of schooling	Estimate the number of cases of school absence that are associated with bullying and multiply by the shadow price. Belfield et al. (2015) calculate the societal willingness to pay for a school day using the national average expenditures for a day of public school. They add the value of increased achievement with fewer days of absence (estimates from existing literature, e.g. Gottfried, 2010, 2011ab). This is considered a very lower bound estimate and does not include potential lasting effects of bullying.	Belfield et al. (2015)
Risk behaviour	a) Calculate specific spending on medical resources required to address specific cases  b) Calculate overall public spending on "at-risk" or "delinquent" youth	Risky behaviour related to health or crime, e.g. smoking, drinking, substance abuse, delinquency and sexual risk behaviour	Belfield et al. (2015) (Sweden)
Conduct problems	Cost-savings on education, crime and unemployment for persons with conduct problems	Measure the child's problem behaviour using the Eyberg intensity score (conduct problems). Estimate the cost savings obtained if a child moves from above to below the clinical cut-off on conduct problems.  Cost-savings estimations are based on published evidence on the effect of conduct problems on education etc. and national statistics on service use.  Shadow price for education: Cost-savings on special education services in primary school. Assume children with conduct problems receive one additional hour per week with a special educator for each of the first four years of primary school. Dollar value using special educator pay rate.  Shadow price for crime: cost-savings from reductions of imprisonment, using published estimate on overall lifetime costs of imprisonment for persons with conduct problems. (assume one-off saving at age 30)  Shadow price for unemployment: Assume that persons with conduct problems are unemployed five months more than average. Monetised using the annual cost of unemployment in terms of welfare payments and losses in taxes. (assume one-off saving at age 30)	O'Neill et al. (2010, 2013) (Ireland)

Kline et al. (2016) find significant impacts on cognitive test scores and value these using the expected increases in lifetime earnings. This is described in the next section. In other studies, the authors aim to evaluate child development but have observable child measures only, such as reading and maths scores (see e.g. van Huizen et al. 2016, which uses PISA scores as a proxy for child development in Spanish preschools).

For further discussion of the importance of soft skills and how they can be assessed and included in cost-benefit analyses, see:

- Jones et al. (2015)
- Kilburn et al. (2008)
- Robinson and Hammit (2010).

O'Neill et al. (2010, 2013) estimate the monetary benefits of reducing children's conduct behaviour. In the programme evaluation, they measure the child's problem behaviour using the Eyberg intensity score for conduct problems and estimate the difference in the probability of reducing conduct behaviour compared to a control group. This impact estimate is then translated to a monetary value using the cost savings obtained if a child moves from above to below the clinical cut-off on conduct problems. The cost-savings are calculated using existing evidence on the effect of conduct problems on education, crime and unemployment combined with published national statistics on these services; see details in Table 6.1. For example, evidence suggests a relationship between conduct problems and education. This is monetised using statistics on special education received by children with conduct problems. The authors assume that children with conduct problems receive one additional hour per week with a special educator for each of the first four years of primary school, which is monetised with the dollar value of special educators' pay rate. The cost-benefit analysis reports IRR and NPV estimates and tests the sensitivity to the cost calculations, where the authors vary the expected effect of conduct problems on crime and unemployment, and also provide a calculation only including the cost-savings in terms of crime. With this approach they take into account double-counting of potential overlapping future benefits and assumptions about which benefits they believe will be lasting and translate into economic returns. Finally, this paper is recommended as an example of how to combine the programme evaluation of an RCT (using cost-effectiveness analyses) with a cost-benefit analysis in one paper.

Because of the limited set of cost-benefit analyses that include a solid analysis of soft benefits, we now focus the remaining chapter on the work from Center for Benefit-Cost Studies in Education (CBCSE). The CBCSE has made the first solid attempts to examine the economic value of soft benefits in a standardised framework (see Belfield et al. 2015 and 2015b). They consider socio-emotional skills from six different early childhood and education programmes. Overall, they recommend calculating shadow prices for behaviour in order to include impacts on children's emotional and behavioural development in cost-benefit analyses.

### **Shadow prices for socio-emotional learning and development**

Belfield et al. (2015) discuss a common framework for assessment of cost and benefits of interventions aimed at improving children's social and emotional learning. The framework is applied to six evidence-based interventions. For each intervention, the authors construct tables of ingredients and their costs (cf. the ingredient method for cost calculations) and benefit maps to summarise possible benefits and monetisation. The authors then report the cost-benefit ratios and net present values along with a set of sensitivity tests. However, they do acknowledge that the full economic value of social and emotional learning is not yet established and that additional research needs to be carried out.

Belfield et al. (2015) discuss shadow prices for ADHD, aggression, social competences, bullying, days of schooling/attendance, substance abuse, delinquency, sexual health status and achievement gains (reading, maths).

Belfield et al. (2015) propose three empirical approaches to finding shadow prices for changes in social and emotional learning and development:

1. Earnings mediated by education
2. Cost-of-illness method: How much is society willing to pay to avoid aggression behaviour
3. Economic burden per “high-risk” youth.

In general, they suggest using the cost-of-illness method, where the shadow prices (for changes in children’s behaviour) are based on what society currently spends on these conditions through the health care system.

They include the impact estimates from the published programme evaluation for each of six interventions and then apply the same shadow price across the six interventions. Given different time horizons and follow-up data in each study, they take the estimated impact and assume that the ratchet effect is zero (no effects in the first year of the intervention) and that the decay rate is infinity (no effects exist beyond the implementation of the intervention; i.e. there are only effects in the second year of the intervention).

Belfield et al. (2015) stress that the extent to which many of these outcomes overlap or confound is unknown. Furthermore, they mention multiple times that it is not possible to tell whether improving behavioural outcomes comes at the expense of achievement gains. To address the latter, they perform a sensitivity test in one of the cases assuming unchanged achievement (or assume fade-out of the test scores effect of 10% or 25% per year), as they worry that spending time on social and emotional learning in class will be at the expense of academic achievement. For that particular intervention, however, the net present value is still large and positive (Belfield et al. 2015: Table 8).

Belfield et al. (2015) also discuss the following methodological concerns: Assumptions about when the impact is observed and fades out, impacts based on teacher ratings and what should be included in costs (e.g. whether regular instruction time should be included). They test the sensitivity of assumptions about the ratchet rate and fade-out effects, allowing the impact of the intervention to persist for one or two years after the intervention. They do not discuss or report standard errors at all.

### **Shadow prices for ADHD, aggression and social competences**

One of the interventions studied in Belfield et al. (2015) is 4Rs, aiming at improving social and emotional learning and literacy among disadvantaged children in grades K-5 (Jones et al. 2011; Long et al. 2015). The primary impacts are reductions in ADHD symptoms (attention skills) and aggression, and improvements in social competencies (socio-emotional functioning). These outcomes are rated by teachers, and the impact estimates range from 0.12-0.14. In order to monetise these outcomes, Belfield et al. (2015) look for shadow prices in the existing literature reporting public spending for groups that are similar to the sample in 4RS. Impact estimates are translated by moving from the median burden to the 45<sup>th</sup> percentile, which is then associated with the respective cost burdens on society. The annual present value of moving the median burden to the 45<sup>th</sup> percentile is then calculated for each outcome and summarised to obtain the total benefit estimate. The present value sum of benefits, i.e. the total immediate benefits of 4Rs expressed as a present value back to the first year of programme delivery, is \$8,320; see Table 6.2.

Belfield et al. (2015) mentions that these shadow prices are conservative in that the cost-of-illness method typically excludes some important costs (e.g. family expenditures). Furthermore, the method considers savings in health expenditures only. As a sensitivity test, they relate the decline in ADHD symptoms in childhood with higher labour market attachment in adulthood. The shadow price is the change in lifetime earnings and is estimated to be 580-780\$; for details, see Table 6.2.

The intervention also measured outcomes related to students' self-reported understanding and handling of feelings (e.g. depressive symptoms), achievement (reading, maths and academic skills), attendance and observations of classroom quality. However, these outcomes are not valued by Belfield et al. (2015).

**Table 6.2** Illustration: Monetisation of behaviour

Outcome	Impact estimate	Shadow price	Source of shadow price	Annual present value (calculated)
ADHD symptoms	0.12	Annual incremental cost per person/year with ADHD	Jones et al. (2009).	\$2,490
		ADHD associated with a 5% change in labour market attachment: Calculate expected change in lifetime earnings	Fletcher (2013) CPS data on earnings.	\$580-780
Social competences	0.14	Annual incremental cost per person/year with oppositional defiant disorder (ODD)	Foster et al. (2005)	\$1,360
Aggression	0.13	Annual incremental cost per person/year with conduct disorder (CD)	Foster et al. (2005)	\$4,470.

Note: Impact estimates and dollar values were obtained from Belfield et al. (2015: pp. 21-25).

### Shadow prices for risky behaviour

Belfield et al. (2015) also consider benefits in terms of less risky behaviour in later childhood and adolescence, for example drug use, delinquency and health decisions, such as smoking or risky sexual behaviour. Potentially, where these outcomes translate into observable behaviours they can also be assessed in monetary values using the same cost-of-illness methods. One example is calculation of the costs of medical resources required to address cases of sexually-transmitted diseases or teenage pregnancy.

Other outcomes from programme evaluations, such as drug knowledge and attitudes, are more difficult to monetarise. For these outcomes, Belfield et al. (2015) suggest using an overall 'at-risk' or "delinquent" youth' shadow price intended to capture all the risky behaviours in aggregate (e.g. using Cohen and Piquero (2009)).

For example, the authors find Swedish estimates of what society currently spends on drug-related behaviours through the health care and criminal and judicial systems (Belfield et al. 2015: pp. 42-45). They use public spending from Nilsson and Wadeskog (2013), Nilsson and Wadeskog (2008) and The National Board of Health and Welfare (2013). The authors then calculate the net benefit given the respective proportions of individuals who are (or are predicted to become) drug users in the intervention versus the comparison group.<sup>11</sup>

<sup>11</sup> The present value of the social burden per drug user is estimated at \$102,920 in 2013 dollars. These estimates are conservative in that they do not include certain costs, such as individuals' loss of income (Belfield et al. 2015).

## Conclusion and Perspectives

The review shows a lack of empirical examples of cost-benefit analyses of early childhood programmes that observe and value soft benefits that are observable immediately after the intervention. Of those analyses that do this, two approaches to find shadow prices for behavioural/emotional outcomes are using the monetary benefits in terms of public cost-savings and using the cost-of-illness/social burden.

In the Nordic context, we may consider how to expand the approaches to include spending in other areas of the public welfare services, e.g. in the social services and education system, and not only spending in the health care system.

Considering the cost-of-illness approach, we might expand this to consider the total cost of social services rather than only the costs imposed on the health care system. In the Nordic context, it may be worth considering how to expand and apply the approach used for adolescent risk behaviours to “at-risk” groups in early childhood. It is desirable to include the average alternative/cost burden on society, including health, education, social services and criminal systems for children not obtaining the skills necessary to attain further education and employment. An empirical suggestion could be to exploit registry data in order to construct observable groups whose characteristics correlate with the hypothetical group with low social and emotional skills and/or behavioural problems.

Establishing a standardised framework that applies the same shadow prices across interventions is challenged when interventions do not even apply the same (or similar) measures of their primary outcome. Therefore, some degree of standardisation of outcome measures in evaluation of early childhood programmes is also important. Compared to academic tests and achievement, the challenge is even greater for soft benefits, where there are various outcome metrics and assessment tools. These outcomes are often rated by the children or staff. Belfield et al. (2015) seems to do reasonably well for the aggression outcome, which they are able to consistently measure and value in five out of six interventions. They suggest that future research should consider how to explore teacher ratings and find appropriate shadow prices for changes in teacher’s ratings of children’s behaviour.

Hence, to pursue more cost-benefit analyses of early childhood programmes, we need more consensus on the outcome measures chosen in evaluations of early childhood programmes and how to define shadow prices. To reach consensus, we suggest that research institutes develop:

1. Standardised databases reporting evidence-based programme evaluations of early childhood programmes.
2. Standardised databases reporting available and recommended evaluation tools to be used as primary outcomes in evaluations of early childhood programmes.
3. Standardised databases reporting national statistics on average and at-risk groups that are commonly targeted in early childhood programmes to be used as shadow prices. These may include:
  - a. Associations between measures of early childhood development and observable outcomes in education, adolescence and adulthood, e.g. associations between national language tests and later outcomes
  - b. Cost-of-illness estimates
  - c. Cost-of-social services estimates.



Altogether, these databases would allow for a more standardised assessment of early childhood programmes relying on 1) evidence-based early childhood programmes, 2) important and standardised primary outcome measures and 3) standardised monetisation of future benefits.

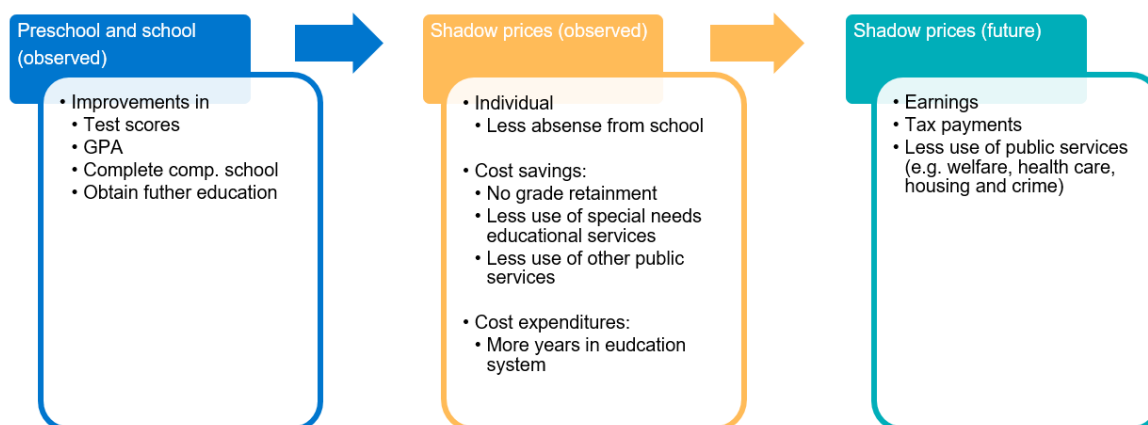
## 6.4 Education and academic achievement

Children’s education and academic achievement are important determinants for future outcomes, such as employment, earnings and health. When considering these outcomes in early childhood programmes, the aim is to prepare children for school, both with respect to learning and social skills. Countries vary in how much attention and weight early childhood programmes and pre-schools give to development of children’s pre-academic skills.

For preschool-aged children, various assessment tests of children’s language and pre-reading and maths skills exist. However, there is no monetary value directly assigned to these scores, but for some children delayed academic skills mean that the child is not ready for school and is therefore kept in preschool for one additional year. Hence, the price of not being ready for school may be used as a shadow price for these outcomes.

In the literature, the shadow price of not being ready for school is calculated as the price of one additional year in pre-school (short run/childhood) or the price of the child entering the labour market one year later due to the delayed entry into the school system (long run/future). Figure 6.4 illustrates other potential outcomes and shadow prices determined in childhood or in the future.

**Figure 6.4** Monetisation of school outcomes



Note: This figure shows examples of outcomes that are observable (red box), potential shadow prices that are observable in childhood (blue box) and potential shadow prices observable in the future as adults (purple box).

In the following, we describe shadow prices for academic skills (test scores), success in school (primary and secondary school, grade retention and special education) and for educational achievement. Figure 6.3 illustrates the outcomes and suggested shadow prices that we have identified in the literature and describe below.

**Table 6.3** Shadow prices for educational benefits

Benefit (aim)	Observed outcome	Shadow price	Describe shadow price
Academic skills	Test scores	Future earnings	<ul style="list-style-type: none"> <li>Predict adult earnings from children's observed test score gains in preschool (Bartik et al. 2011, 2012; Bartik 2013; Kline et al. 2016)</li> <li>Predict adult earnings from children's observed test score impacts. Including sensitivity test for different fade-out rates (Belfield et al. 2015)</li> <li>Links effects on PISA test scores to earnings using existing estimates from cross-national PIAAC estimates (Van Huizen et al. 2016)</li> </ul>
	Test scores	Future crime	<ul style="list-style-type: none"> <li>Predict adult crime from children's test scores gains in preschool (Bartik et al. 2011, 2012)</li> </ul>
Do better in school	Reduction in grade retention	Cost savings on education system	<p>The assumption is that grade retention increases the cost for a student to complete their education.</p> <ul style="list-style-type: none"> <li>Calculate the annual cost of K-12 education (Masse and Barnet 2002; Reynolds et al. 2002; Barnet et al. 2004; Heckman et al. 2010; Reynolds et al. 2011)</li> </ul> <p>For example, Reynolds et al. (2011) use the average per pupil annual expenditure in Chicago for general education. Assume that grade retention results in an additional year of school at age 19. The cost is discounted back 16 years to age 3.</p>
	Reduction in grade retention	Future earnings	<ul style="list-style-type: none"> <li>Predict adult earnings from observed reductions in grade retention, using links from other data sources (Bartik et al. 2016)</li> </ul>
	Reduction in grade retention	Future crime	<ul style="list-style-type: none"> <li>Predict adult crime from observed reductions in grade retention, using links from other data sources (Bartik et al. 2016)</li> </ul>
	Reduction in grade retention	One extra year of employment in the future	<ul style="list-style-type: none"> <li>Use as shadow price the effect of one extra year of employment (or the employment rate of 21-year-olds) (Van Huizen et al. 2016)</li> </ul>
	Special education	Cost savings on special education in the education system	<ul style="list-style-type: none"> <li>Calculate the incremental annual cost per student for special education (Masse and Barnet 2002; Reynolds et al. 2002; Reynolds et al. 2011; Barnet et al. 2004; Heckman et al. 2010)</li> <li>Calculate cost-savings on hours/week with special educator based on national statistics from Ireland (O'Neill et al. 2010, 2013)</li> </ul>
Education attainment	Attainment: High school, vocational, college	Cost savings on education system	<ul style="list-style-type: none"> <li>Observe education attainment as adult (Heckman et al. 2010,2010b; Zerbe et al. 2009)</li> </ul>

### Shadow prices for tests scores

In general, test scores are valued using the associated change in lifetime earnings. Increasing lifetime earnings will benefit the participating individual in the form of increasing income and society and non-participating individuals in the form of higher tax payments.

The estimated impact of the early education programme is multiplied by the associated change in lifetime earnings. The association between test scores and lifetime earnings is obtained from the existing literature (e.g. showing that a standard deviation of 1 in test scores is associated with a 0.25

standard deviation increase in earnings). Test scores are most often results from reading, language or maths tests, GPAs (grade point averages) or exit exams.

The approach (linking improvements in test scores with increased lifetime earnings) is used in Heckman et al. 2010, Chetty et al. (2011), Heckman, Pinto and Savelyev (2013) and Chetty, Friedman and Rockoff (2014). We recommend these papers for best-practice readings.

Our review of the past decade's CBAs found the following applications:

- Bartik et al. (2011, 2012) evaluating a pre-K programme in Tulsa
- Bartik (2013) evaluating the Pre-K programme Kalamazoon County Ready 4s
- Belfield et al. (2015) evaluating six interventions across early childhood to youth
- Kline et al. (2016) evaluating preschool programme Head Start.

Kline et al. (2016) observe children's cognitive test scores as primary outcomes of the Head Start intervention. The tests are collected yearly after preschool enrolment, and the last observation in data is when the children are about seven years old and in grade one. To value the impact on test scores in grade one they apply lifetime earnings. Based on estimates from test score impacts in grade one, they extrapolate and estimate the associated change in lifetime earnings. They use the present discounted value of lifetime earnings at age three from Chetty et al. (2011), which is \$438,000. The authors discuss distributional effects but end up extrapolating the mean test score impact only. They conclude that this will likely understate the effect of the programme for children in the lower part of the distribution. The paper is very thorough, and although it includes test scores valued as earnings only, the authors provide important discussions and results on distributional test score effects, composition of peers in preschools and fiscal externalities when preschool becomes available to more children. The discussion shows what the policy-relevant parameter estimate is dependent on whether the state invests in preschools in a market where preschools are full or have vacancies.

### **Shadow prices for K-12 education, grade retention and special education**

Shadow prices for K-12 Education (i.e. primary and secondary education) and special education (in the US) are fairly established through the previous cost-benefit analyses of known programmes, such as Abecedarian (Masse and Barnett, 2002) and Chicago CPS (Reynolds et al. 2002; 2011). Also, the WSIPP have done a thorough analysis and provide estimates (Aos et al. 2004). Generally, they calculate and use the national or the state's annual costs of K-12 education and special education as shadow prices for education measured as less need of retaining a grade (and thus saving one year of education costs) and special education (and thus saving the incremental, annual cost of one more student with special education. Karoly (2008: Table 3.3) provides a table summarising the dollar costs of K-12 and special education.

Batik et al. (2011, 2012) and Bartik et al. (2016) follow children enrolled in a Tulsa preschool in 2005-2006 and collect follow-up outcomes on test scores and grade retention, respectively. In Bartik et al. (2016), follow-up data until 9<sup>th</sup> grade in 2015-16 is collected. Treatment effects are identified using propensity score matching with children enrolled in preschools that were not a Tulsa preschool. Bartik et al. (2011, 2012 and 2016) are thus able to combine estimates on observable outcomes, and associations between these, to link impacts in preschool to future outcomes.

Bartik and coauthors project and estimate the impact of participating in the Tulsa preschool program on children's future earnings using test scores in preschool (Bartik et al. 2012) and grade retention during grades 1-8 (Bartik et al. 2016)). To obtain estimates for the relationship between test scores

and grade retention and future earnings, they use estimates from the literature and separate data analyses. They perform a separate correlation analysis on NLSY97 data, where they are able to go back in time and follow cohorts of children aged 12-17 in 1997 up until 2013, i.e. till they were in their early 30's. In this sample, the authors estimate the correlation between children's grade retention and earnings as adults. The estimate is then applied (multiplied) by the impact estimates of children's test scores and grade retention in their experimental sample. The same analysis is performed for crime, under the assumption that improving children's education level will reduce future delinquency and crime, so that cost savings on crime becomes an additional shadow price for preschool and education. Finally, the papers may be used to compare cost-benefit estimates based on different projections.

### **Shadow prices for educational attainment**

In our review, a set of the studies includes observations of educational attainment, for example whether the children attain less than high school, high school or college:

- Heckman et al. 2010, 2010b
- Zerbe et al. 2009
- Reynolds et al. 2011.

We consider these studies in order to describe the types of shadow prices used to value educational attainment.

Heckman et al. (2010) monetise the benefits of education using the cost-savings in the education system as shadow price. They consider the costs for K-12 education, GED and special education, vocational training and colleges. For K-12 education, costs include the public costs for society and assume no private costs to the individual. For special education, costs are the incremental costs of providing special education to one additional student. For vocational and college programmes, the costs include tuition fees and other pecuniary costs paid by individuals to education institutions. Society's costs for education include the additional costs when individuals attain more schooling (i.e. higher levels of education), which may offset cost savings from reduced use of special education or grade retention. We recommend consulting this paper for best-practice examples on calculations of public and individual spending on education, comparisons of different extrapolation and imputation techniques, and tables that carefully report cost-benefit results disaggregated on stakeholders with standard errors.<sup>12</sup>

Zerbe et al. (2009) collect data on foster care children's educational attainment at age 24 to compare the impact of the Casey foster care program to standard services. They estimate the impacts on having completed less than high school, high school, college or post-college and find significant impacts on three out of four outcomes, which are then monetised. The monetary value is expressed in the value per unit (e.g. high school degree) using lifetime earnings as the shadow price. Lifetime outcomes are extrapolated from the last observed follow-up data at age 24. They allow higher lifetime earnings associated with the greater educational attainment. The difference in earnings are predicted to increase because of life-cycle effects, productivity growth of about 1.5% per year and differences in work life and mortality (obtained from other published work). In addition, the additional costs of higher education for the individual (tuition fees and lost earnings while in education) are included. Note that Zerbe et al. (2009) chose not to value the education-attainment-categories that

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<sup>12</sup> The methods are elaborated in the working paper version (Heckman, Moon, Pinto, Savelyev and Yavitz 2010: NBER 16180). In particular, they compare the extrapolation results for education using three different techniques and accounting for uncertainty.

are insignificantly different from those in the control group. The authors discuss this choice and sample size considerations.

### **Conclusion and perspectives**

Shadow prices for education and special education (in the US) have become fairly established through the previous cost-benefit analyses of early programmes, such as Abecedarian (Masse and Barnett 2002) and Chicago CPS (Reynolds et al. 2002, 2011). This was possible due to the relatively extensive data on the education and labour market outcomes of the populations, along with national or state expenditures on education, health and criminal systems. However, the approach is stylised, and shadow prices rely on observing market-valued benefits (e.g. a high school diploma or earnings).

The literature is still immature with regard to observing and valuing non-market benefits from education, e.g. improved learning development, decision making, information processing and digital skills. There is an increasing focus on how preschools and schools also strengthen areas other than academic achievements. This is also seen in the Programme for International Student Assessment, PISA, which now includes different domains concerning information processing, expectations about the future and, in PISA 2021, creativity.

In our review of the past decade's CBA's, we have searched for examples that observe and value other educational outcomes that are softer and reflect improvements in learning for the average students in the classroom that are not at risk of being referred to special education programmes.

The best-practices, however, are through observed test score gains. Many countries have implemented various assessment systems that systematically assess the academic standards of students in K-12 education, and some even in preschool. There is a large potential in expanding the use of these assessment tools in evaluations and cost-benefit analyses. Firstly, because the assessment tools are out of the hands of those participating in the intervention (e.g. preschool educators) or evaluating the intervention (e.g. the programme funder or researcher), which increases the objectivity and reduces the risk of Hawthorn effects. Secondly, because it would be possible to obtain a (national) systematic catalogue of associations between standard assessment tools and children's future outcomes, which could be applied as links in costs-benefit analyses.

## **6.5 Child abuse and neglect**

Early childhood interventions targeted at children exposed to child abuse or neglect aim at improving the home environment and/or the child's development. The home environment may be improved through strengthening parenting skills and the parent-child relation (see e.g. Doyle et al. 2011). Other interventions may aim at improving the child's behavioural/emotional and cognitive development through programmes in child care or foster care institutions (e.g. Lynch et al. 2014).

In order to put an economic value on these improvements, we need a set of shadow prices for reducing child abuse and maltreatment.

For high-risk cases, the price of child abuse is child death, and in such cases we can use the price of a statistical life from the health literature. Corso et al. (2011) provides an example of how to estimate the (society's) willingness to pay to prevent a death caused by child maltreatment. They survey 1000 respondents and derive willingness-to-pay estimates using contingent valuation.

However, we may also want to assess the value of smaller improvements for children exposed to child abuse and neglect, but not at risk of death; e.g. the value of a better functioning family with less violence and more supportive parents. If this is the case, we will need a shadow price that includes the individual value of a better home environment for the child plus the public cost-savings in terms of child protective services. This assumes that improvements in family functioning will improve the child's upbringing and future life trajectories and reduce the risk of the child being placed out of home.

Potential shadow prices for individual child improvements:

- Improved cognitive development
- Improved emotional/behavioural development
- Improved education and thereby future economic outcomes.

Potential shadow prices in terms of cost-savings on public services:

- Cost of child protective case
- Cost of out-of-home placement
- Cost of other social services for children in abusive families
- Cost of child death.

These shadow prices may be derived using the methods described in the previous sections. Very limited empirical applications exist, however. We recommend consulting Aos et al. (2004) for best-practice.

### **Shadow prices for child abuse cases**

Aos et al. (2004: p. 47-52, Table C1a) reports effect sizes from a meta-analysis of early childhood programmes that measure and monetise outcomes for child abuse and neglect (6-7 international programmes).<sup>13</sup> Aos et al. (2004) estimates costs of a child abuse case as:

- Estimated average public costs of a child protective service divided by costs incurred by taxpayers and victims<sup>14</sup>
- Medical, mental health and quality-of-life costs per victim of child abuse and neglect.

In Karoly (2008), only few of the reviewed cost-benefit analyses observe child abuse and neglect (see Table 3.2b)<sup>15</sup>, and only one monetises the outcome (see Table 3.6). Monetisation of child abuse and neglect is done by public cost-savings from reduction in cases of child abuse and neglect (for the Chicago CPC program; Reynolds et al. 2002). The public costs include the administrative costs, public medical and mental health costs, tangible victim costs and intangible victim costs.

There is a discrepancy in the magnitude of the shadow prices for child abuse from Aos et al. (2004) and Karoly (2008), even though they use the same ingredients (public services and administrative

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<sup>13</sup> Examples of self-reported outcomes: ever having indicated report of child abuse; number of reports of child abuse; number of child abuse and neglect events (self-reported); number of minor physical aggression events (self-reported); number of minor psychological aggression events (self-reported).

<sup>14</sup> Calculation of public costs of a child abuse case is the probability of a case \* the probability of a case \* the price of the case service \* the average number of cases. They calculate the probability of being abused based on national statistics.

<sup>15</sup> One example is Healthy Families New York (HFNY), which includes a five-year follow-up where the authors measure benefits for the children exposed to child abuse in terms of improvements in family functioning outcomes. Family functioning outcomes are measured observing the parents.

costs), which reflects differences in the use of national or state prices and the proportions of the costs that are assumed to incur to the victim or society.

From our literature review, we identified three cost-benefit analyses considering child protective services<sup>16</sup>:

- Tiba and Furak-Pop (2012) evaluating a cognitive behaviour programme in families at risk of child separation
- Lynch et al. (2014) evaluating an early childhood programme for children in foster care
- Zerbe et al. (2009) evaluating two types of foster care programmes.

The studies differ in their approaches to observing and valuing outcomes (out-of-home placement). Tiba and Furak-Pop (2012) use the cost-savings approach, whereas Lynch et al. (2014) value outcomes using the willingness-to-pay approach (WTP).

Lynch et al. (2014) run an RCT for children entering foster care with the aim of creating permanent placement for the children. The intervention improved outcomes for children with emotional and behavioural problems. They value these outcomes by comparing how much society is willing to pay for having children placed in permanent placements and show the result graphically for a range of hypothetical WTP values.

In Tiba and Furak-Pop (2002), the primary outcome is the number of child separations three months after the intervention started, i.e. avoiding to place at-risk children in out-of-home care. They do not find significant differences between children (families) who receive the cognitive behaviour therapy (CBT) programme and the control group that receives systemic-based intervention. Thus, they do not proceed to conduct a cost-benefit analysis of the CBT programme. Instead, they calculate the cost-savings when avoiding child separations, and the paper may be used as an example of this. The estimated cost-savings include the costs of out-of-home care and the cost of the caseworker in the child protective system.

### **Conclusion and perspectives**

The review shows a scarcity of cost-benefit analyses that use shadow prices for reducing child abuse and maltreatment or improving the exposed children's development. For best-practice, we refer to earlier work from Aos et al. (2004).

Children exposed to child abuse and neglect receive different types of child protective services (social services). Reducing exposure to abuse in the home may reduce the need or change it to less intensive services. Thus, the public cost-savings on child social and protective services may be used as shadow prices for reducing child abuse and neglect. However, more intensive protective services may be the best option, e.g. separating the child from the parents in out-of-home care. If this type of services is used, the short-term costs will most likely exceed the benefits (if long-term benefits for the child are not included).

Furthermore, social services like child protective services are multidimensional. Therefore, it is important to disaggregate different types of social services into smaller categories reflecting the needs of the recipient. The reason is the at-risk children are less likely to completely leave the social service system. However, an impact may be seen as a reallocation from a more demanding and expensive social service to a less demanding and less expensive service. From a cost-perspective,

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<sup>16</sup> The literature search also found a number of cost-savings analyses of foster cares from the perspective of the state (e.g. Maher et al. 2012; Johnson-Motoyama et al. 2013)

an increase in the take-up rate of the less demanding services would be (more than) cancelled out by the decrease in the more demanding services.

In countries with public institutionalisation of social services, it should be possible to obtain this kind of information on use of different social services. An example is provided in The Danish Model for Social Programmes (SØM), which provides a database including effect sizes, outcomes and prices to be used for cost-savings analyses of social programmes in Denmark (Beuchert and Jacobsen 2018).<sup>17</sup> In Denmark, the National Board of Social Services (2018) have ordered child social services in six levels based on how intrusive the child protective service is for the individual's everyday life, in order to illustrate six steps of social service intensities. Preventive programmes (e.g. in child care) are considered the least intrusive (step 0), preventive programmes at home (e.g. weekly social worker visits) are considered a first step of social services (step 1), whereas out-of-home placement in institutions is considered the most intrusive (step 5). Combining this classification of social services with detailed, person-level registry data on usage of social services, six registry outcomes are defined to be used as standardised outcomes in the model. In addition, the model provides national statistics on costs for each of the six groups of social services (Beuchert and Jacobsen 2018).

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<sup>17</sup> The model and databases are inspired by Washington State's model (WSIPP). The Danish model, however, calculates cost-savings for the public only (local, regional and national agency) and does not include or monetise individual benefits.



## 7 Monetisation of future adult benefits

In this chapter, we consider future adult benefits from early childhood interventions, including benefits in the domains of economic outcomes, health, crime and social services. The main challenges are prediction of the future outcomes, as they are unobserved, and the monetisation of the outcomes – especially those without a market value. The general methodology and challenges are described in Section 7.1, and applications for each of the benefit domains are described in the following subsections (economic outcomes, health, crime and social services).

### 7.1 General methodology and challenges

Even for childhood interventions targeted at very young children, the economic outcomes in adulthood receive much attention in the CBA studies and are very often included (see e.g. Table 5.3). As even small positive effects on, for instance, earnings will sum up to a substantial amount of benefits over the life cycle, it is clear that such earnings estimates are important to include in a CBA.<sup>18</sup> It is also clear from Section 6 that adult outcomes often serve as (future) shadow prices for childhood outcomes that are otherwise difficult to monetise.

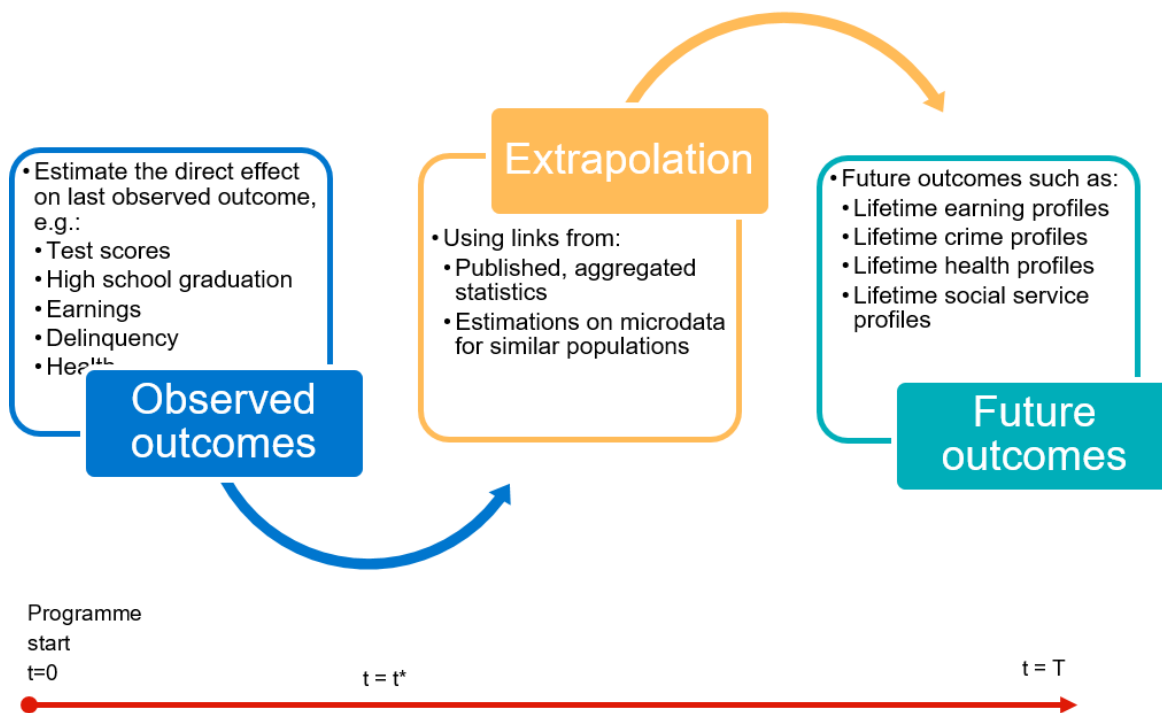
When including and monetising adult outcomes in CBAs, data availability is an important issue. For some studies, long-run follow-up data exists, which provides measures for crime history and current earnings at age 30, for instance (e.g. Heckman et al. 2010; Garcia et al. 2016). As described in Section 5.4.5, interpolation and imputation is often needed to estimate some of these outcomes for the years between observation points, as the available data may contain very few observation points (especially in the case of survey data, whereas administrative registry-based data are often available on – at least – a yearly basis).

In order to include the value of outcomes for the full lifecycle, projection and monetisation of the economic outcomes in the years after the last observational year are required. This is illustrated in Figure 7.1. Data availability is often limited, which restricts the feasible methods for projection. In the reviewed studies, two types of data are used for projections: Aggregate level data and microdata.

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<sup>18</sup> The economic life cycle typically encompasses multiple life stages from childhood, adolescence, adulthood to retirement.

**Figure 7.1** Illustration of extrapolation to future outcomes



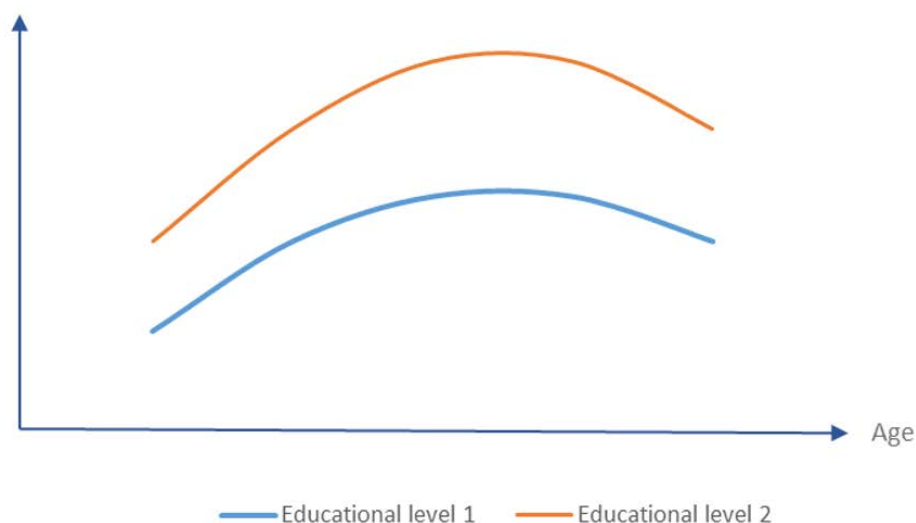
Note: This figure illustrates the method of extrapolation from observed outcomes to future outcomes. The timeline illustrates the lifecycle from programme start ( $t=0$ ) till the lifecycle ends in year  $t=T$ .  $t^*$  is the last observed data point. After  $t^*$ , data is extrapolated to  $t=T$ .

A substantial share of the studies included here project future outcomes by using aggregated statistics, e.g. on a national level. In some applications, such aggregated statistics are calculated for subgroups such as gender and age (-groups), and then very simple calculations will give the projected estimates of the outcome profile. Sometimes estimates exist for only one or a few age categories – (e.g. if estimates are obtained from other studies), and in such cases further assumptions are needed to make a projection of the outcome for the full life cycle.

Other studies, e.g. Garcia et al. (2016), use an auxiliary microdata set to project the outcomes after the observations of the original data. Such microdata are used to construct a “synthetic” population to use for prediction of outcome profiles to be assigned to the individuals of the study population, so that subsequent years can be included. To make the “synthetic” population as similar to the study population, it is often necessary to select individuals on some observable characteristics, e.g. gender, ethnic background or educational level. The type of microdata set available influences the choice of prediction models for estimation. If the data set is longitudinal (i.e. the same individuals are observed two times or more), the model can be estimated including the lagged dependent variable. The estimated coefficient of the lagged dependent variable (sometimes labelled “linkage”) can be used to predict the time profile of the dependent variable. If the available microdata are cross-sectional data, it is not possible to estimate such linkages. In these cases, the estimated model should include a specification of the age profile – eventually inspired by theory or other empirical studies. Figure 7.2 shows an example of such profiles for life time earnings, where the profiles are specified as a quadratic function. Garcia et al. (2016) discuss in detail how they combine observed data and auxiliary microdata from different sources.

**Figure 7.2** Earnings profiles for two educational levels

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Using an auxiliary microdata set appears to be a good solution to the projection problem. However, two issues should be considered: Firstly, the microdata will include a different population from the study population, and it should be considered to what extent the auxiliary data source is representative of the study population. Secondly, the information in the auxiliary data will typically represent a time period other than the time period for which we need projections, and hence it should be noted that societal structures may have changed over time, and the longer the panels are, the higher is the risk of the information used being outdated.

With respect to monetisation of the future adult benefits, the challenge varies depending on the domain under consideration. Some of these are easy to monetise, e.g. earnings and welfare payments, as they are directly measured in monetary terms. Others are less obvious, like the monetary value of reduced crime and health improvement. Researchers often need to consult the literature for the relevant sectors and eventually obtain information on expenditures from the authorities.

## 7.2 Economic outcomes (earnings and employment)

In this section, we describe how economic outcomes like earnings, employment and social welfare are projected and monetised in the surveyed literature.

Among the potential economic benefits from early childhood interventions, earnings are by far the most dominant outcome included in cost-benefit analysis. This corresponds with the fact that earnings is often used as a shadow price for a series of child outcomes, as we showed in Section 6. We identify two approaches to extrapolating earnings: The first approach uses estimates based on aggregated data, summary statistics from other studies or full population microdata, and the second approach uses (auxiliary) microdata sets to construct a synthetic population.

In the literature review, we identify the following cost-benefit analyses projecting earnings based on aggregated data, summary statistics from other studies or full-population microdata.:

- Zerbe et al. 2009
- Reynolds et al. 2011
- Bartik et al. 2009
- Kline et al. 2016
- Van Huizen et al. 2016
- Bartik 2013.

Zerbe et al. (2009) assumes that productivity grows 1.5% per year, and this implies that the projected difference in earnings between treatment and controls increases over the life cycle. Furthermore, the difference in work life and mortality is accounted for (obtained from Gamboa 2002).

Reynolds et al. (2011) uses national average net earnings at age 25-29 for a relevant group (black full-time employees) divided into four educational categories. They add a fixed rate of fringe benefits, and these earnings are assumed to increase at a fixed rate until the age of 65.

Bartik et al. (2009) make highly simple assumptions regarding earnings, namely in assuming that the estimated earnings effect kicks in at age 20 and persists (in real terms) until age 50.

Several studies use estimates of how improved school achievement increases earnings. Kline et al. (2016) apply the dollar value of the estimated gains from Chetty et al. (2011), in order to convert test score effect estimates of the Head start intervention to future earnings gains. These estimates from Chetty et al. (2011) have also been used to project life-time earnings in Bartik (2013).

Van Huizen et al. (2016) use a similar approach, where they apply existing estimates of correlations between PISA test scores and earnings to predict future earnings from average earnings data obtained from EUROSTAT.

We have identified three studies applying the second approach, where (auxiliary) microdata sets are used to construct synthetic populations for projection of earnings/income profiles:

- Bartik et al. 2016
- Heckman et al. 2010
- Garcia et al. 2016.

Bartik et al. (2016) use NLSY97 to estimate earnings ratio profiles for four socioeconomic groups and apply these ratio profiles to calculate the predicted earnings from the observed baseline of the intervention study. They note that transferability from the NLSY to the Tulsa experiment may be an issue, as the population and timespan differ.

Heckman et al. (2010) projects earnings using three different data sets and applying three different approaches, depending on the data set. In the first approach, they use the CPS data set to calculate age-by-age growth rates of a three-year moving average. This is done by race, gender and educational level. The growth rates are then linked to the observed earnings at age 40 in the study population. For the second approach, they extract a low-ability subsample, estimate a random effects model with lagged earnings and a few other observables as regressors, and use the model to extrapolate earnings after age 40. The third approach is to estimate a House (1980) earnings model and use the parameters for prediction. They discuss these choices and conclude: "the three methods are conservative in that they impose the same earnings dynamics on treatments and controls".

Garcia et al. (2016) projects two types of income, namely labour income and transfer income. They use CNLSY for predictions for ages 21-30 and a pooled version of NLSY79 and PSID for ages 30-67. They extract the synthetic populations for prediction based on year of birth, gender and siblings at birth, in order to mimic these characteristics of the study population. They estimate models to use for prediction of the two types of income. The model includes lagged dependent variables, i.e. labour/transfer income. The fact that actual labour and transfer income in the study population are observed at age 20 and 30 (as well as the few other individual characteristics controlled for in the estimated model) means that predictions specific for the individuals in the study population can be included in the cost benefit analysis.

Employment is related to earnings and income and these are only rarely explicitly/separately projected in the surveyed literature, even though employment is usually observed where long term follow-ups are performed. However, earnings data will often implicitly account for periods out of employment. This is the case if, for instance, earnings levels applied for the basis of projections are yearly (average) earnings for individuals – irrespective of their employment rate during the year. However, it is not always clear from the studies whether this is the case.

The approach used by Garcia et al. (2016) is more transparent in this respect, as they split income into annual labour income and annual transfer income (which is likely to include welfare payments when unemployed).

Van Heuzen et al. (2016) explicitly projects the employment effect, using estimates from existing literature (Carneiro 2007) to estimate the employment increase due to the skill effect. Furthermore they combine the projected employment effect and the earnings effect to estimate the increase in life-time earnings due to the lower level of retention for the treatment group, as the lower likelihood of retention will result in earlier labour market entry.

Another related outcome is unemployment, and O’neill et al. (2013) estimate the unemployment effect in their study population and monetise this using the estimated public savings in transfers and gains in tax payments from the literature (Moffit et al. 2002).

To include welfare (cost savings), Heckman et al. (2010) make life-term projections of costs of welfare, and Garcia et al. (2016) projects annual transfers, as explained above.

### 7.3 Health outcomes

Another central outcome that is potentially affected by early childhood intervention is health, which is eventually affected over the full life cycle and therefore important to include in a cost benefit analysis. For example, the Abecedarian program has been shown to improve adult health significantly (Campbell et al. 2014).

We have identified four categories of benefits (all cost savings) in the reviewed literature:

- reduced expenditure on health care
- reduced costs related to substance abuse
- better health status
- reduced costs related to the workplace.

We present the evidence for these categories in turn.

Health costs expenditure for health care is included in the analyses in Reynolds et al. (2011) and Garcia et al. (2016). Reynolds et al. (2011) includes direct treatment cost expenditure savings associated with depression, by projecting the likelihood of depression from the presence of depressive symptoms observed at ages 22-24. The authors state that they use a conservative estimate of depression, as they assume that it will last for two years in total. The cost-of-depression estimate is based on the average annual cost of indicated depression in the US (Greenberg et al. 2003). In Garcia et al. (2016), the medical cost prediction models are estimated from medical registries, and then the parameters are used to make predictions for the study population based on the observed health state and other observed characteristics. The costs are estimated for three separate categories, namely for annual Medicare spending, medical spending paid by the individual and other public spending than Medicare.

Health benefits in terms of reduced future substance abuse may be relevant to include for early childhood programmes that aim at strengthening child development (e.g. self-control and self-regulation) and thereby reducing later risk-taking behaviour, such as drinking and smoking. Reynolds et al. (2011) includes the benefits due to reduced substance abuse. Conviction for drug possession is used as the primary indicator for substance abuse in the observed data. The cost estimate is based on the cost of drug abuse over ages 14-60, as reported by Cohen (1998). The cost of drug abuse includes rehabilitation and treatment expenses, workplace productivity, medical costs associated with potential overdose and other drug-related illnesses, risk of premature death and opportunity costs of resources associated with the manufacture and sale of drugs. Reynolds et al. (Ibid.) also include estimated benefits due to reduced rates of daily smoking based on the mortality costs of smoking (from Viscusi and Hersch 2007).

Substance disorders are also considered in Zerbe et al. (2009), together with other mental disorders (depression and anxiety disorders) and physical disorders (ulcers, cardiometabolic and respiratory conditions). Zerbe et al. (2009) include the cost savings from fewer chronic physical and mental disorders, and they constitute a large net benefit. However, it is unclear how the projections are made. The cost savings include direct medical costs only and not avoided loss in earnings or quality-of-life measures, for instance. Health benefits through generally better health status are included, using approaches from the public health literature. Garcia et al. (2016) include the benefit from better health status over the lifecycle. They assess the health status of individuals at each age, using "quality-adjusted life years" (QALYs) previously used in public health literature. The basic idea of the QALY measure is that it reflects the utility value associated with a given state of health by the years lived in that state (Weinstein et al. 2009). One year of life lived in perfect health is worth one QALY (1 year of life  $\times$  1 Utility value), whereas one year of life lived in a state of less than perfect health is worth less than one QALY. Monetisation of the value is done using willingness-to-pay measures (e.g. Huang et al. 2018). In our review of the literature, only Garcia et al. (2016) is identified as including QALYs as a measure of health status. In order to calculate the QALYs, Garcia et al. (2016) use methods and models applied in medicine. Health outcome profiles are estimated from auxiliary samples, and the estimated transition probabilities are matched with the study population based on the observed characteristics – including drug use, blood pressure and hypertension. The QALYs are predicted from these transition probabilities. Note that QALYs are estimated for the full life in order to monetise health in the observational period as well as the projection period.

Health benefits in terms of being more healthy and productive can also be included using measures from the workplace. Reynold et al. (2011) is the only study in our review that includes work-related cost savings as being a consequence of better health. Costs of absenteeism and reduced

productivity are included in their cost of depression estimate based on the average annual cost of depression (Greenberg et al. 2003).

## 7.4 Crime outcomes

Another potential benefit identified and included in the reviewed cost-benefit analyses is the benefit attributable to reductions in crime.

The projections of criminal outcomes are typically based on various observable outcomes, such as arrests, convictions and imprisonment. Furthermore, the outcomes may be divided into types of crime, e.g. violent offences and property offences. To monetise the benefits of reduced crime, cost data is needed. We have identified two types of cost associated with crimes included in the cost-benefit analyses: i) expenditure for the justice system, which includes costs of police, the costs of the court system and costs related to incarceration in juvenile detentions and prisons, ii) victimisation costs, including medical costs, lost productivity, stolen or damaged property, and ideally also the cost of nontangible quality of life of victims and their families.

Typically, the projections of crime are based on various observable outcomes of recorded crimes. Hence, unobserved (i.e. undetected) crimes are not included, and this will tend to introduce a downward bias of the victim costs. Two studies corrects for this using “victimisation inflation”, namely Heckman et al. (2016) and Garcia et al. (2016).

We have identified five studies basing the projection of benefits of reduced crime on simple assumptions regarding, for instance, timing of crime and/or previous estimates for the total costs of a crime career reported in other studies:

- Reynolds et al. 2011
- White et al. 2010
- Heckman et al. 2010
- Schweinhart 2013
- O’neill et al. 2013.

Reynolds et al. (2011) projects crime for juveniles by imposing a series of assumptions on the timing of the crime and dispositions of court petition – a methodology they have also used in a previous paper (Reynolds et al. 2002). For adulthood, they use the estimated cost of a criminal career for age 19-44, as reported in Greenwood et al. (1998). This cost of a criminal career assumes a 10% annual decrease in the crime rate. The cost measure includes expenditure for the justice system as well as both tangible and intangible victims cost in terms of losses for violent offences and property offences based on national estimates

White et al. (2010) extrapolates effects on observed criminal behaviour of juveniles in the study population into adulthood assuming an initial adult crime rate of 80%. Subsequently, it is assumed that the decline in the crime will be 10% per year. To monetise the intervention effect, they use the cost of an adult criminal career, as estimated by Greenwood et al. 1996, as well as estimates of tangible and intangible victimisation costs.

Heckman et al. (2010) and Schweinhart (2013) (both analysing the Perry Preschool intervention) observe the cumulated arrests and sentences in the study population up to the age of 40. The full lifetime crime profiles for various types of crimes are estimated by adding the age, gender and year-specific arrest rates obtained from national statistics for the remaining ages. Heckman et al. (2010)

calculate "incidence-to arrest ratios" to adjust for the fact that not all crimes are observable in the statistics, i.e. they account for "victimisation inflation". The unit costs of crimes applied in the study include victim costs, police and court costs, and correctional costs. Special attention is given to the victim costs of murder, as cost-benefit analysis results are highly sensitive to this due to the specific temporal pattern of murders in the observed data.

O'Neill et al. (2013) refer to previous evidence of links between conduct problems, which is their primary outcome, and the future outcomes, which are criminal activity, being arrested and spending time in prison. In order to monetise the benefits, they apply estimates of the overall lifetime cost of crimes for persons with conduct disorder and mild conduct disorder, respectively (from Friedli et al. 2007).

Two studies base the projection of reduced crime on results from estimations using auxiliary microdata sets:

Bartik et al. (2016) use NLSY data to estimate crime ratio profiles for four socioeconomic groups, and from the observed baseline data they apply these ratio profiles to calculate the predicted number of violent and property crimes. To monetise the crime cost, they use the median of estimates from seven previous studies.

Garcia et al. (2016) observe arrests and sentences in the study population up to their mid-thirties. Using the same approach as described above for other outcomes, they use auxiliary microdata from administrative sources to estimate models for the number of sentences from the mid-thirties onwards, including the number of sentences at mid-thirties as a regressor. Using this procedure, they can use the estimated parameters of the model to predict the number of future sentences for the study population (including the observed outcomes in the mid-thirties). This type of model is estimated for various kinds of crimes. Based on the registry data, they calculate the number of victims and use "victimisation inflation" to account for unobserved crimes, as only crimes recorded in the justice system are observable. The cost of crimes for victims is calculated based on the estimates from McCollister et al. (2010). Finally, the total costs of crimes are calculated, using cost information the justice system (including police costs), costs of incarceration and total victimisation costs.

## 7.5 Social services

As seen in Table 5.1, one domain that is not projected in any of the reviewed studies is adult use of social services not included in health care services. Examples of this would be assistance for disabled persons, care homes for homeless people, support for young mothers etc. In a Scandinavian welfare state context, this would be relevant and possible to include, as these are services that are institutionalised and provided by the public sector.

Including this type of social services may be difficult, especially if there are no available data on the use of these services. In countries where these services are provided by the public sector, however, these data are more likely to exist and be accessible through administrative registries.

### **Conclusion and perspectives**

From the reviewed literature, it is clear that there is substantial variation in methods for projection of future adult outcomes across studies. The earlier studies tend to use simple aggregate data projection, whereas studies like Bartik et al. (2016) and Garcia et al. (2016) use auxiliary microdata from other sources, e.g. administrative data or longitudinal panels. Even though this latter approach



raises issues on the representability of the populations and transferability of results across time periods, it seems to be a line of research that should be pursued further. Especially, because econometric modelling of, for instance, longitudinal data enables researchers to account for observable and unobservable characteristics.

In a Danish/Scandinavian context, the availability of full population longitudinal registry-based data covering several decades provides a solid basis for using auxiliary microdata for projections. These data include a wide range of outcomes in the domains usually included in the surveyed literature, such as labour market outcomes, welfare payments, health, crime and social services.

A related topic is that looking into other research disciplines, such as health and criminology, provides us with useful information on relevant outcomes, cost estimates for monetisation and general methods that may be useful and even transferable to cost-benefit analysis. Examples of this are Garcia et al. (2016), who adopt the health status measure (QALYs), and Reynolds et al. (2011), who include estimates of the cost of drug abuse over ages from previous research.

## 8 Assumptions, methods and choices

As demonstrated in this review, state-of-the-art cost-benefit analysis builds on a substantial number of assumptions and methodological choices. In this section, we summarise and discuss central issues, namely the choice of included impacts, accounting for uncertainty and performance of sensitivity analysis. Finally, we discuss sensitivity and issues for reporting cost-benefit results.

### 8.1 Which impact estimates should be included and valued

The review reveals several concerns about which impacts from primary outcomes should be included and monetised, how they should be monetised, how they should be projected to future outcomes, and how they potentially overlap. In this section, we summarise and discuss this further.

#### 8.1.1 Assumptions about impact evolvment

When extrapolating from an observed impact in preschool or school (e.g. a test score impact) to future outcomes in childhood or adulthood (e.g. earnings), we need assumptions about the impact evolvment over time – is the estimated impact permanent or does it fade out before the child enters adulthood?

We consider the example of extrapolation from a test score impact in preschool to lifetime earnings. If we assume the estimated test score impact to be permanent (until age 18 when a person enters the labour market), then the estimated test score impact is to be multiplied by the associated change in lifetime earnings at age 18.

Evidence tends to indicate, however, that test score impacts of early childhood programmes seem to fade out as the children grow older (but impact on non-cognitive development persists) (see e.g. Kruger and Whitmore 2001; Heckman and Kautz 2012; Chetty et al. 2011; or the discussion in Duncan and Magnuson 2013). Therefore, it may seem more reasonable to apply a decaying rate (for example 10% per year until age 18) to the test score impact before extrapolating the effect into adulthood (for examples see Belfield et al. 2015: Table 10 applies a fade-out of 10% and 25% per year).

In Belfield et al. (2015), they assume both the ratchet function and the fade-out function to be zero.<sup>19</sup> They perform sensitivity testing, where they vary the rate of fade-out (for example 10, 25 or 60% fade-out per year). Although a fade-out function of zero may seem to be an optimistic assumption, the authors argue that it is unlikely for interventions to be delivered under the assumption that they will have temporary effects only (Belfield et al. 2015). However, multiple studies have shown that test score effects fade out over time. Thus, viewed in this light, the assumption seems optimistic (see e.g. Duncan and Magnuson 2013).

Secondarily, there is a risk of extrapolation of overlapping impacts from childhood (e.g. test scores and behavioural scores) to future outcomes. For example, if in addition to impacts on test scores the intervention also showed positive impacts on behavioural scores. To avoid double-counting of both the value (in terms of earnings increases) of test score gains and gains in socio-emotional

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<sup>19</sup> The ratchet function determines how impacts develop over time. When the ratchet function is assumed to be zero, the impacts of the programme only occur in the year in which they are measured. The fade-out function determines how the estimated impact persists through time. When the fade-out function is zero, the benefits are assumed to persist through school and adulthood.

skills, it may seem reasonable to apply fade-out on the test score impact, if the full effect on socio-emotional skills is also valued.

For a similar discussion of assumptions regarding fade-out of test scores related to extrapolations to crime outcomes; see Schweinhart (2013).

### 8.1.2 Assumptions about significance

Primary impact estimates are made with uncertainty. When monetising impact estimates, we use the point estimate, but the point estimate is also uncertain. There may also be point estimates in a block of outcomes that are insignificant, which may cause the researcher to choose either to value all point estimates in the block or only those that are estimated to be significant. A block of similar outcomes could be five categories of obtained education (mutually exclusive categories), categories of social services or test domains (this approach is used in Doyle et al. 2013).

If we choose to monetise all observed outcomes in a block (insignificant or significant), we risk including benefits that are not significant or that are already accounted for through other (similar) childhood outcomes. Hence, this issue is also related to the potential risk of double-counting future benefits, if too many similar childhood outcomes are being valued (see below).

In the literature, we see the following approaches when choosing which specific outcomes to monetise:

- Only include and value significant outcomes
- Include and value all outcomes in a “block” (e.g. if there are five education achievement categories but one is insignificant)
- Include and value all outcomes with an economically meaningful effect size.

When point estimates are estimated very precisely, this is not a concern. However, many programme evaluations are based on small samples without enough power to detect a significant impact.

In studies that take a more conservative approach, only outcomes that show a significant difference for the treated children are monetised (for example if only three out of five educational attainment categories are significant, only those three are included in the calculation of benefits) and outcomes that do not overlap (for example, if lifetime earnings can be calculated based on either education or income data, only one of the two is included). The argument is that monetising additional benefits would affect the programme positively (increasing the cost/benefit ratio) and that it would be more conservative not to do so. Examples of such studies include Zerbe et al. (2009) and Belfield et al. (2015).

One of the state-of-the-art papers, Heckman et al. (2010), addresses this issue by assessing the uncertainty in the standard errors reported. Here, the standard errors in all outcome estimations are bootstrapped. The authors value all observed outcomes for the treatment group and control group separately, and then calculate the dollar differences irrespective of significant differences (Heckman et al. 2010: Table 3). The costs are reported for each group and outcome separately, which supports transparency and lets the reader consider potential double-counting. Reynolds et al. (2011) also report the same set of CB results and sensitivity test for all subgroups in their paper, although they do not all show a significant effect on the primary outcomes.

Finally, Belfield et al. (2015) propose using fidelity-adjusted impact estimates for interventions in which the average impact is insignificant, but significant for the subsample of schools with high implementation fidelity.

### 8.1.3 Double-counting of benefits

This concern arises when similar childhood outcomes show significant effects as well as being valued using the similar shadow prices, for example, in the case of test scores monetised using expected improvements in lifetime earnings; if there are significant gains in both reading and maths scores, are they both to be added to the monetary benefit of the programme? The common approach is to only monetise one of the test scores (or an average) and possibly test robustness using the other.

Reading and maths scores are considered fairly similar proxies for the same type of skills, i.e. cognitive skills, but the concern is also relevant when considering effects on both cognitive and non-cognitive skills: Should we monetise both? Given that higher achievement scores are correlated and associated with better soft skills (see e.g. Almlund et al. 2011), it may be difficult to distinguish the two constructs and monetisation of both (using the same or different shadow prices) may lead to double-counting in benefit-cost analysis because of their overlap (Belfield et al.2015).

In the WSIPP model, the researchers developed a procedure to avoid double-counting (Aos et al. 2004). The procedure describes a set of decision rules to avoid double-counting of outcomes that reflect the same underlying construct, and another decision rule when there are both direct and indirect pathways to the same future outcome.

Reviewing the cost-benefit analyses of the past decade, we find very little discussion and testing of this concern. The common approach is to report costs and benefits separately for different domains, so the reader can see the relative contribution of different benefit domains. Studies that discuss overlapping benefits may report cost-benefit ratios valuing all benefits together and separately, thus leaving out potentially overlapping benefits. Belfield et al. (2015) draw benefit maps in which they highlight possible benefits and which are potentially overlapping. Consequently, they include only one of the set of outcomes at a time in their benefit calculation. Similarly, Zerbe et al. (2009) calculate impacts of foster care on outcomes measured at age 24. They estimate lifetime earnings from impacts on educational attainment and employment data (resulting CB ratio is 1.46) and lifetime income from impacts on income data (resulting CB ratio is 1.7). They do not aggregate the two benefits because, the authors argue, they both reflect improvements in human capital and it would be double-counting.

For the sake of transparency regarding the potential overlaps, we recommend reporting cost-benefit results based on aggregated benefits (with potential double-counting of benefits) and separately.

### 8.1.4 How should spill-over effects on family members be included?

As discussed above, it is hard to decide how many potential benefits should be included and monetised in cost-benefit analyses. Yet a set of potential benefits may arise from spill-over effects on family members (List et al. 2019). For example, positive impacts on parents' labour supply from substituting time from home care to work (Bartik et al. 2016; Kline et al. 2016; Van Huizen et al. 2016), improvements in parents' parenting skills through programme participation (Doyle et al. 2013) and improvements in siblings' development through improvement of the individual child's development (List et al. 2019). For long-term studies of early childhood programmes it may even be

possible to consider impacts on the participating children's future children (Barnett and Masse 2007; Zerbe et al. 2009).

Spill-over benefits for family members are added to the calculation of total benefits; see Figure 8.1. Thus, the total benefits of a programme may include the direct effects (on the participating child) and the spillover effects (on members of the participating child's family).

**Figure 8.1** Spill-over benefits for family members



Note: This figure illustrates that total benefits should include benefits for the participating child as well as their parents, siblings and own future children.

Spill-over effects on family members are included and monetised using the same approaches as for the participating child; recall the illustration in Figure 2.1. First, we identify the potential programme benefits based on theory or causal models of mechanisms. Second, we estimate the effects on family members' observable outcomes measured after the programme, and then we monetise these effects using the same approaches (e.g. shadow prices) as applied for the child's outcomes. Fourth, we recommend that spill-over benefits should be subjected to the same set of sensitivity tests as other benefits.

As with child benefits, it is important to describe thoroughly the potential benefits and how these are observed and monetised in the cost-benefit analysis. In particular, if the programme evaluation failed to detect significant programme impacts on the participating child the researchers should be very careful when arguing why spill-over effects on family members might still be considered as potential benefits of the programme.

A limited number of the reviewed costs-benefit analyses include spill-over effects on participating children's family members.

Van Huizen et al. (2016) include the effect of universal preschool on mother's employment. They include the short-term employment effect and the long-term wage effect in the cost-benefit analysis. The short-term effect is the observed effect of universal preschool on the mother's employment in the year of preschool, which is then monetised using the average earnings for mothers in the sample. The long-term wage effect is monetised by extrapolation of the observed employment effect using age-specific employment rates and evidence from previous published papers on preschool expansions. The cost-benefit results are illustrated by reporting the share of total benefits disaggregated for children (child development), parents (mother's employment), tax payers and society.

Parents' earnings (and taxes) are included in Kline et al. (2016) and Bartik et al. (2016) by extrapolating observable employment or earnings when children are enrolled in preschool programmes, though, Kline et al. (2016) do not monetise parents' labour supply in their final cost-benefit analysis because previous papers had found the effect to be insignificant.

Zerbe et al. (2009) discusses and observes benefits for the participating children's own children. They estimate and compare the effect of two foster care programmes on children's adult outcomes, such as the number of children and whether their own children are placed in out-of-home care. However, since the estimated differences between the two groups are insignificant the outcomes are not monetised in the cost-benefit analysis.

The review has not found any cost-benefit analyses that include potential outcomes of siblings or own children that are not observable in data.

## 8.2 Sensitivity and uncertainty

The estimation of benefits are sensitive to the model specifications and assumptions, which in turn affect the final benefits-cost ratio. The uncertainty associated with projections of future outcomes based on early outcomes is also rarely discussed.

Karoly (2008: Table 5) found that very few cost-benefit analyses reported standard errors of cost-benefit estimates. The only study reporting standard errors is Reynolds et al. (2011). Our review of the recent cost-benefit analyses show that there is still no consensus on reporting standard errors: However, about half of the studies report standard errors on the benefit-cost ratio. This suggests that the field has developed in this respect and that solid cost-benefit analyses address uncertainty.

Uncertainty may arise from estimation error and prediction errors, which should give rise to sensitivity tests. Table 8.1 reports and summarises different approaches to uncertainty and estimation of standard errors used in the reviewed studies.

Best-practice papers include a large set of sensitivity tests of the methodological choices, such as the included benefits and costs and the monetary valuation (see discussion above), discounting and uncertainty. For example, Heckman et al. (2010) compare benefit-costs ratios after applying four different interpolations techniques and different assumptions about deadweight loss and cost of crime.

For further reading, we recommend the following papers:

- Heckman et al. (2010) apply permutation tests and bootstrap standard errors that at the same time take into account small sample sizes and uncertainty.
- Vining and Weimer (2009, 2010) provide a general discussion about uncertainty in estimation of cost-benefit ratios and how to exploit this, using Monte Carlo simulation methods.
- Bartik et al. (2016) address uncertainty of the impact estimates (projected to future earning) by calculating the CB ratio based on the upper and lower bounds of the point estimates. In addition, they have a transparent table reporting the CB results and sensitivity tests for all subgroups.

**Table 8.1** Uncertainty and standard errors

Standard errors	References
Bootstrap standard errors.	Heckman et al. (2010);
Monte Carlo simulations	Vining & Weimer (2009,2010)
In Heckman et al. (2010), standard errors are calculated by Monte Carlo resampling of prediction errors and bootstrapping. They develop a procedure to take into account uncertainty and include three steps: i) bootstrap standard errors, ii) adjust all imputed values for prediction errors by plugging in an error term that is randomly drawn from comparison group data in a Monte Carlo resampling procedure and iii) compute CB ratios for each replication to obtain bootstrapped standard errors.	Heckman et al. (2010: Appendix Part K) or Heckman et al. (2010b) for details.
Jackknife repeated simulations (Kish and Frankel, 1974)	Zerbe et al. (2009: footnote 17)
Sensitivity of standard errors to clustering on school or birthday	Bartik et al. (2012)
Report standard errors calculated by the delta method. Standard errors are clustered at the Head Start centre level. The authors discuss asymptotic properties for the delta method, and as a sensitivity test they bootstrap standard errors. Report bootstrap p-values from one-tailed tests of the null hypothesis that the benefit-cost ratio is less than 1. This test is computed by a nonparametric block bootstrap of the t-statistic (by resampling Head Start centres).	Kline et al. (2016)
Address uncertainty of the impact estimates (which are projected to future earning) by calculating the CB ratio based on the upper and lower bounds of the point estimates. In addition, they have a good and transparent table reporting the CB results and sensitivity tests for all subgroups.	Bartik et al. (2016: Tables 5 and 6)
Report 90% confidence intervals for the public CB ratios, where the confidence intervals are generated by monetising the standard errors associated with the estimated programme effects (i.e. monetised in the same way as each impact estimate).	Reynolds et al. (2011: Appendix C); Temple, Reynolds, and White (2007); White, Temple, and Reynolds (2009)
Do not report standard errors but report CB ratios for various upper/lower bounds of the impact estimates that are monetised.	Van Huizen et al. (2016: Figure 2)

Note: This table summarises approaches to accounting for uncertainty in cost-benefit analyses.

### 8.3 How to address distributional effects

The following papers discuss distributional concerns:

- Kline et al. (2016) evaluating Head Start
- Bartik et a. (2012) evaluating pre-K programme in Tulsa
- Bartik (2009b), handbook chapter
- Van der Poi et al. (2017)
- Klaiber and Smith (2012), methodological paper
- Vining and Weimer (2010), methodological paper.

Bartik (2009b) from the Upjohn Institute for Employment Research discusses the distributional effects of early childhood programmes and business incentives, including the effect on the income distribution and social mobility. The paper (handbook chapter) does not conduct a cost-benefit analysis but provides a discussion in which benefits from targeted early childhood programmes (targeted poor children) are compared to universal day care by assuming different effects over the distribution. Benefits are measured in terms of future adult earnings. In the cost-benefit analysis of

Pre-K in Tulsa, they apply this and estimate treatment effects for different test score percentiles and income groups (Bartik et al. 2012).

Kline et al. (2016) provide the most elaborate discussion on distributional effects and fiscal externalities from expanding early childhood programmes. The concern is how the positive impacts on children generalise or change, if Head Start is expanded to more children. They provide four main contributions.

First, they provide a discussion of potential heterogeneous effects across the test score distribution. The main results are based on an extrapolation of the mean test score impact on lifetime earnings. They conclude that this likely understates the effect of the programme for children in the lower part of the distribution.

Second, they provide a discussion of how the composition of the peers in preschools may change as a result of improved access to (high quality) preschools. This assumes that the running/expansion of Head Start increases the number of preschools. The paper shows (empirically and theoretically) how to include structural changes in the market from substitution of children a) from public preschools to Head Start preschools, b) from home care to public preschools and c) from home care to Head Start. They consider this in a LATE setup, where they identify the proportion of compliers and then subgroups of compliers for each case.

Third, they provide a discussion of fiscal externalities and how the public costs-savings (found from Head Start) are affected when more children generally enter preschools as a result of the setting up of additional Head Start centres (then it is no longer a question of substitution between regular preschools and Head Start preschools). This means that public saving on other preschools is reduced. However, the authors also expect test score gains among more children (those who would have been in home care). They analyse this in a LATE framework where they try to identify the proportion of compliers and look at the proportion of public costs saved. After accounting for fiscal externalities, the authors conclude that the costs of Head Start only exceed its benefits if its test score impacts translate into earnings gains at a lower rate than similar interventions for which earnings data are available." (Kline et al. 2016: p. 1823).

Fourth, the discussions are expanded to distinguish between the cases where the preschools are rationed (i.e. restrictions or waiting lists on preschool enrolment) and non-rationed. However, this case is less relevant in the Scandinavian case with universal preschools.

## 8.4 How should results from cost-benefit analyses be reported?

In general, the results of cost-benefit analyses are sensitive to various methodological choices and assumptions. As this report shows, there is still no consensus on even the most common benefits of early childhood interventions or how to monetise these. For research, and policy, it is thus important that it is transparent and easy to see which costs and benefits are included and how.

It is recommended to use at least the following parameters in cost-benefit analysis:

- Method for impact evaluation
- Main programme features (e.g. sample and programme content)
- Transparency in estimated costs and benefits
- Transparency in calculated cost-benefit ratio
- Discounting, age and year discounted to



- Uncertainty (report standard errors)
- Sensitivity (report sensitivity tests of the cost-benefit ratio to critical assumptions or parameter values)
- Disaggregation on stakeholders.

Methods for impact evaluation and the main programme features are important for the reader to be able to assess causality and generalisability of the study. It is also central to understand what benefits and costs the data allow for.

To achieve transparency in estimated costs and benefits, the authors must at least describe which outcomes are affected by the programme and which of these the authors are able to monetise and include in the cost-benefit calculation. For example, the impact evaluation may show significant impacts on participating children's behaviour and achievement tests. However, the authors are only able to include and monetise achievement impacts in the cost-benefit analysis. The authors should then clearly describe the estimation and projection methods used to monetise the impacts, including whether they capture only the tangible or intangible benefits of that outcome or both benefits.

Reporting of costs and benefits for different stakeholders is also recommended to understand what is included. To get a full picture of the aggregate costs and benefits of a public intervention, we prefer to include all the costs and benefits for the individual (the programme participants), the government (tax payers) and society. A through cost-benefit analysis should report the total cost and benefits at the disaggregated level to illustrate the costs and benefits from each perspective (i.e. the perspective of the individual, the tax payer and society).

For an empirical example of transparent reporting of included benefits and costs, we recommend Belfield et al. (2015). They draw benefit maps that illustrate clearly which impacts are estimated in the evaluation and which are monetised and included in the cost-benefit analyses. They also show how benefits potentially overlap. For transparency in costs, they report in tables all intervention inputs and dollar values. Also, see Box 5.1 in Belfield et al. (2015) for their recommendations for reporting of cost-benefit analyses.

For an empirical example of transparent reporting of CB ratios and sensitivity tests, we recommend Bartik et al. (2016). Bartik et al. (2016: Table 5) reports the benefits and cost components in dollars and the resulting B/C ratio and IRR. The table is transparent, as it is clear what is included in the benefits (from earnings and crime) and programme costs. In addition, the table shows similar numbers for all subgroups considered in the paper. Moreover, Table 6 is an expansion of Table 5, which shows robustness tests for the same set of subgroups.

## 9 Discussion and concluding remarks

We reviewed cost-benefit analyses published in the past decade, identifying a total of (only) 15 cost-benefit analyses with a solid description of costs and benefits. In addition, we identified a number of studies discussing methodological issues or the importance of including soft benefits in cost-benefit analyses of early childhood programmes, and this is a field with a large research potential.

Below, we summarise the main findings:

- Well-established and recommend methods exist for collecting and calculating a programme's costs.
- Methods for monetisation of benefits are less established.
- Children's cognitive development is observed in seven studies, but in only four of these studies is cognitive development monetised and included in the cost-benefit analysis. Even fewer cost-benefit analyses include and monetise children's behavioural and emotional development.
- Several types of benefits are actually cost-savings and thus only monetise the benefits to the public.
- Private childhood benefits are monetised using projections to expected future earnings increases from improvements in the observed childhood outcomes.
- The literature lacks good solutions for how to monetise the soft, short-term benefits that the child gains from participating in early childhood programmes, i.e. the value of a better childhood (emotional development, wellbeing, more stable families etc.)
- The best practice example we have found is a comparison of six programmes in a standardised framework from CSBCC.

Over the time period considered in this report, we have observed a progress in the analyses:

- More benefits are included as data becomes available
- More data also allows for development of more comprehensive shadow prices and comparison of benefits using different shadow prices
- Comparisons of projected benefits (from earlier studies) with observable benefits, as participants grow older and their future outcomes become observable in later data.

The progress becomes apparent when reading the set of cost-benefit analyses that are conducted for Chicago CPC and Perry Preschool – from the evaluation performed immediately after programme participation until age-40 follow-up data are collected.<sup>20</sup> These studies illustrate how development of data access and estimation methods has served to improve and refine the analysis by in turn leading to use of more data, inclusion and monetisation of more benefit domains, the carrying out of sensitivity analyses, and calculation of standard errors to better assess uncertainty.

The most recent studies that are based on observed data when the children reached age 40 compares the actual benefits as adults with those that were projected in earlier studies (Reynolds

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<sup>20</sup> Appendix Tables A3.1 and A3.2 illustrate the development in cost-benefit analyses of Chicago CPS preschools and Perry Preschool, respectively.

et al. 2011; White et al. 2010).<sup>21, 22</sup> The studies show an increase in the estimated net benefits and CB ratio as outcomes are observed at older ages and the associated forecast period declines (Reynolds et al. 2011). This suggests that the forecasts applied at younger ages tended to understate the future benefits for such outcomes as earnings, reduced crime and reduced welfare use (Karoly 2016).

Thus, there should be a continuing focus on improving precision in projection methods for monetising future benefits. Projections are largely improved by availability of historical panel/longitudinal data that allow the researcher to create synthetic control groups for projections. However, there is a trade-off between exploiting either long panels of historical data or making projections based on recently observed data.

Based on these findings, we arrive at the following recommendations for performing cost-benefit analyses and future development of cost-benefit analyses, respectively.

### **Recommendations for performing CBAs**

Based on our findings, we arrive at the following recommendations for practice that will strengthen transparency and comparability across cost-benefit analyses of early childhood programmes. Eventually, greater comparability across cost-benefit analyses of early childhood programmes will allow for better policy informing and decision-making.

### **COSTS**

- **Costs should reflect incremental costs and include opportunity costs**

The programme's costs should reflect the additional costs that are required to run the programme compared to the alternative programme or business-as-usual. Included are opportunity costs of for example teachers' or parents' time devoted to programme participation. Costs in terms of later cost-savings to the public sector are not included in the costs of the programme.

- **Use the Ingredient Method for cost collection**

The Ingredient method specifies each element and unit price and thus ensures transparency. Preferably, the cost of the programme should be collected while the programme is running.

- **Report both total costs and disaggregated costs**

We recommend reporting total costs and costs disaggregated on each cost domain (e.g. professional training, operational costs and administrative costs). This will allow the reader to see which components are driving the costs and comparisons across programmes. Cost calculations should be complemented with a description of the choices and assumptions that are critical for the total cost calculation and provide alternative estimates (e.g. upper and lower limits).

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<sup>21</sup> Reynolds et al. (2011) re-estimate the complete cost-benefit analysis and compare the result with the previous studies from 2001 and 2002 based on age-15 and age-21 data, respectively. The study includes earnings projection to age 65. The study also addresses discounting, attrition and uncertainty. Uncertainty is addressed by running Monte Carlo simulations of the cost-benefit results.

<sup>22</sup> White et al. (2010) look at the crime projections in more detail. They re-estimate the earlier projections of future crime benefits based on newer data, where they are able to observe children as adults (age 26). This allows for a comparison of *ex-ante* and *ex-post* crime projections. The study shows that the earlier (*ex-ante*) projections were conservative.

## BENEFITS

- **Benefits should include private and public benefits**

For a full cost-benefit analysis of an early childhood programme, benefits for the participating child (i.e. private benefits), for the taxpayers paying for the programme (i.e. public benefits) and for society (i.e. private and public) should be included. Benefits may be positive or negative.

- **Describe which benefits are observed, monetised, and projected**

Benefits should include all public and private benefits. This is hard to achieve, however. We therefore recommend devoting particular attention to the description of choices made with regard to included benefits. Selection of included benefits should be based on theory or causal evidence. We recommend drawing benefit maps (Belfield et al. 2015) to clearly illustrate which benefit domains are expected to be influenced by the programme (short and long term), which are possible to monetise, and which are monetised and included in the final cost-benefit ratio.

- **Report point estimates that are monetised**

We recommend reporting point estimates (and standard errors) of all benefits considered, and then clearly marking (and discussing) which are to be monetised and included in the cost-benefit ratio. Reporting the point estimates that are later to be monetised would greatly improve the transparency and comparability of cost-benefit analyses in the field.

- **Report total benefits and disaggregated benefits**

We recommend reporting total benefits and benefits disaggregated on each benefit domain (e.g. cognitive, behavioural/emotional, earnings and crime) and disaggregated on stakeholders (e.g. private, government, society). This will allow the reader to see which benefits are included or missing, which are driving the total benefits, and which benefits potential overlap. Reporting disaggregated benefits also allows reporting of alternative estimates on each benefit (e.g. upper and lower confidence limits).

- **Describe monetisation**

For each benefit: Describe how the dollar value is estimated and applied to the point estimate. For observable benefits: Describe the observed data, estimation method and shadow prices. For future benefits: Describe the last observed data, estimation/projection methods and shadow prices.

- **Use of microdata for projections**

We recommend that projections (e.g. earning profiles) be based on microdata for children that are similar to the participating children.

## THE COST-BENEFIT RATIO

- Discount costs and benefits to same age
- Discounting is critical in order to readily compare all costs and benefits occurring over the child's life from programme participation to adulthood. Report the age to which costs and benefits are discounted, to allow the reader to recalculate for other ages (i.e. to compare with programmes that start at different ages).
- Perform and report sensitivity analysis.
- To test how critical assumptions and choices made are for the final cost-benefit ratio. The uncertainty surrounding the final cost-benefit estimates may be illustrated graphically by CB ratios based on worst and best-case estimates of the point estimates that are monetised or projected (e.g. upper and lower confidence limits).
- Report cost-benefit ratios.

- We have recommend reporting disaggregated values of costs and benefits including alternative estimates to address uncertainty. This will make it transparent how total benefits and costs are calculated, what is included and excluded, and which domains drive the resulting cost-benefit ratio. Likewise, we recommend reporting the final cost-benefit in a table that also reports cost-benefit ratios subject to sensitivity tests.

Finally, above we recommend reporting a large set of alternative estimates on costs and benefits. These sensitivity analyses may also help reduce the lack of standardisation and comparability across CBAs, by presenting the reader with the CB ratio from alternative choices.

### **Future development of CBA**

Our review took as its point of departure a thorough review: Karoly (2008), and later Karoly (2012), focusing on standardising a framework for cost-benefit analyses of early childhood interventions. The review illustrated a lack of standardisation and methodological challenges.

In this study, we reviewed cost-benefit analyses published in the recent decade (i.e. 2007-2017), identifying a total of (only) 15 cost-benefit analyses with a solid description of costs and benefits. We conclude that the field to some extent still lacks standardisation as to which benefits to include and how these should be monetised. However, we acknowledge that more studies attempt to include, project and monetise several domains – including domains that are non-monetary by nature, such as health and crime.

Based on our review, we make the following suggestions for future development of CBA methods:

- Shadow prices for “soft” child outcomes like emotional/behavioural development and child wellbeing need to be developed to allow monetisation of short-term effects in these domains.
- More systematic data collection is needed to assess children’s early development, in order to gain knowledge on the relationship between child development and adult outcome.
- Information on the relationship between children’s developmental problems and their use of public services is scarce. More research is needed in this area.
- The advantages of using microdata and advanced statistical methods for projections should be explored further.
- The inclusion of “unfamiliar” domains can be improved significantly by consulting the relevant fields of research for theoretical and methodological practices.

These recommendations reveal that the lack of standardisation is largely due to lack of data and lack of monetary values of important outcomes of early childhood programmes. This means that the availability of data will determine to a great extent which benefits it is possible to include and at which relevant shadow prices. Furthermore, as limited information is currently available on early childhood development and the monetary value of this, cost-benefit analyses rely heavily on projections of future benefits. Until now, studies comparing early projections to later calculations based on actual outcomes suggest that the early projections were conservative, i.e. that they underestimated the realised, long-term benefits (e.g. Reynolds et al. 2011). This indicates that projection of more benefit domains may be needed in order to capture all future benefits of the early childhood programmes. Furthermore, over time the possibility of comparing *ex-ante* projections and *ex-post* actual observations will increase, and such comparisons will enable researchers to evaluate the performance of various projection methods.

We find that projections are improved by availability of historical panel/longitudinal microdata, and we recommend that future analysis should explore the potential in the availability of these data in

various domains. As previously discussed, the availability of later follow-up studies enables researchers to compare the performance of various projection methods with actual outcomes. However, it is important to acknowledge that though this may be an important methodological exercise, early childhood interventions in the 1970s and 1980s may be of limited relevance for today's policymakers.

A related issue is the advantages of including long-term projections of outcomes in the cost-benefit analysis. As demonstrated in this review, the inclusion of long-term outcomes often mitigates the problems of the difficulties in monetising short-term outcomes for children, e.g. due to a lack of data on short-term outcomes and the ability to monetise these. The most applied example of this is the inclusion of future earnings in many of the reviewed papers. It is certainly important to include the (actual or projected) adult outcomes in order to include all potential benefits over the lifecycle. However, every time long-term projections are made, we need to make a lot of assumptions and impose a structure, and this implies that uncertainty increases significantly. The availability of a longitudinal data set does not completely offset this disadvantage, as these data are also historical and it is uncertain whether the estimated projections from these data will be representative for future behaviour/outcomes.

The latter recommendation concerns the potential of consulting all relevant fields of research in order to apply the best methods and data when attempting to include various benefit domains. We believe that substantial knowledge exists in the various fields of research that will improve the quality of, for instance, the estimated relationships between child development and adult outcomes. Furthermore, this knowledge can serve as inspiration for approaches to monetisation of both short and long-term "soft" outcomes.

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# Literature: From systematic search

## Results of the systematic literature search

In this appendix, the results from the systematic database search are reported ordered by publication type (recall Table A2.3 that maps search results by publication type).

### Cost-benefit analyses

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# Bilag 1 Documentation of the Literature Search

**Table A1.1** Literature search: Inclusion Criteria

	Inclusion criteria	Rationale
Focus	Cost-benefit analyses of one or more early childhood interventions	Cf. the research questions formulated in Chapter 1.
Study design	<p>Cost-benefit analysis including a description of costs and benefits and reporting a CB ratio or IRR.</p> <p>Primary benefits obtained from study designs: social experiments, randomised controlled trials (RCT), quasi-experiments, natural experiments (regression discontinuity design, difference-in-difference, IV), systematic reviews, meta-analytic designs, reviews and impact evaluations.</p> <p>Primary benefits must be estimated or reported.</p>	<p>We include cost-benefit analyses that conduct a full cost-benefit analysis.</p> <p>We include economic evaluations that sought to compare at least two interventions (or an intervention with treatment as usual) in terms of their costs and benefits.</p> <p>Primary benefits must be estimated or reported in order to monetise benefits.</p> <p>Reviews and impact evaluations may contain cost-benefit analyses or methodological discussion although this is not the primary research objective.</p>
Publication year	Studies published from January 2008 to December 2017 (both months included)	A large review exists based on previous studies (Karoly 2008). Our aim is to expand this review with recent publications.
Publication type	Cost-benefit analyses, cost-savings analyses, journal papers, working papers, technical reports, web appendixes, reports, policy reports, books and book chapters	We are interested in the grey-area literature (such as working papers, technical appendixes and guidelines) to identify the best practices and methodological developments in cost-benefit analyses of early childhood interventions.
Fields	<p>We search in the fields of social sciences: economics, public policy, psychology and sociology.</p> <p>We exclude development economics, health economics and medicine.</p>	Our focus is social programmes not clinical experiments.
Interventions	<p>Interventions and programmes aimed at early childhood development, cognitive or non-cognitive development, social and emotional learning (SEL), mental health, literacy and language, school readiness, school attendance, academic attainment, risky behaviour, personal skills, life skills, and parent training and adult-child interactions.</p> <p>Interventions that are implemented at home or in centre-based institutions (family centre, child care, day care nursery school), preschools, kindergarten, schools (primary or secondary; K-12), after-school activities, and youth and mentor programmes (e.g. crime prevention programmes).</p>	<p>Our aim is to identify state-of-the-art methods. Thus, the specific aim of the intervention is of less importance. This means that our search is very broad and that we may have to spent additional resources on the initial screening of papers to identify those meeting our methodological quality standards.</p> <p>We exclude papers on school and accountability reforms, teenage pregnancy prevention programmes and employment programmes. We also exclude papers on medical treatments.</p>
Institutional context	Developed countries	We exclude cost-benefit analyses from developing economics. This is partly due to resource constraints and partly due to our main research objective, which is to describe best-practice methods for cost-benefit analyses of programmes and child outcomes of interest in Scandinavian public policy.
Publication language	Studies written in English, Danish Swedish or Norwegian.	<p>This is a resource constraint. In addition to studies written in English, which is the preferred publication language in Denmark, we only search studies in Danish, Swedish and Norwegian.</p> <p>We expect studies of particular interest for cost-benefit analyses of Scandinavian early childhood programmes to be published in one of these languages.</p>

Note: This table reports the inclusion criteria formulated for the electronic database searches

**Table A1.2 Strategies for Searching the Literature**

Search of electronic databases (no. of studies)	Description
<ul style="list-style-type: none"> <li>▪ Academic Search Premier (548)</li> <li>▪ EconLit (348)</li> <li>▪ ERIC (275)</li> <li>▪ IDEAS/RePEc (37)</li> <li>▪ Social Science Citation Index (332)</li> <li>▪ SocINDEX (77)</li> <li>▪ Sociological Abstracts (216)</li> <li>▪ Rapport (1)</li> <li>▪ Various (4) (Danish National Research Database)</li> </ul>	<p>Systematic literature search by VIVE's Librarian.</p> <p>The following combinations of search terms are used:</p> <p>a) "Cost" and "benefit"</p> <p>b) "Early childhood intervention", "education intervention", "youth intervention"</p> <p>In the databases Econlit, Sociological Abstracts and RePEc, we used the following search strings:</p> <p>ab(benefit OR cost OR cost-benefit OR internal rate OR rate of return)</p> <p>AND</p> <p>ab(early childhood OR preschool OR kindergarten OR daycare OR nursery OR child care OR literacy OR language OR education OR K-12 OR school OR youth OR mentor OR vocational training OR training OR preparatory OR parenting OR family OR home-visiting OR center-based)</p> <p>AND</p> <p>ab(intervention OR program OR investment OR development OR training)</p> <p>The search resulted in a total of 1838 studies.</p>
<b>Manual search of websites</b>	
<ul style="list-style-type: none"> <li>▪ Google and Google Scholar</li> </ul>	<p>Searching for Danish cost-benefit analyses.</p> <p>Searching for research organisations doing cost-benefit analyses of early childhood interventions (see below).</p> <p>Searching Google Scholar for studies from the electronic database search to identify similar or related studies.</p>
<b>Search of research centres and organisations</b>	
<ul style="list-style-type: none"> <li>▪ RAND Labour and Population</li> <li>▪ Center for Benefit-Cost studies in Education (CBCSE)</li> <li>▪ Society for Benefit-Cost Analysis (SBCA)             <ul style="list-style-type: none"> <li>▪ Washington State Institute for Public Policy (WSIPP) Benefit-Cost Analysis Database</li> </ul> </li> <li>▪ NBER Working Paper Series</li> <li>▪ World Bank, Impact Development Blog</li> <li>▪ J-PAL             <ul style="list-style-type: none"> <li>▪ Evans School Benefit-Cost Analysis Center Research and Projects</li> <li>▪ Brookings Institute (see the SGM model; Sawhill et al. 2014)</li> </ul> </li> </ul>	<p>Searching list of publications and other public available resources (e.g. templates or description of common standards).</p> <p>Searching for methodological discussions and references (e.g. in policy briefs or blogs).</p>

- The Heckman Equation Project Database: [www.theheckmanequation.org](http://www.theheckmanequation.org)
- MacArthur Foundation Database
- Center on the Developing Child at Harvard University
- Department of Health and Social Care (England)
- CPB Netherlands Bureau for Economic Policy Analysis

Scandinavian:

- The national board of health in Denmark (Socialstyrelsen)
- The national board of health and welfare in Sweden (Socialstyrelsen)
- NUBU – Nasjonalt utviklingscenter for barn og unge (Norway)
- The Copenhagen Consensus Center (Denmark)

### Footnote chasing

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>▪ References in Karoly (2008)           <ul style="list-style-type: none"> <li>▪ References in Aos et al. (2004)</li> </ul> </li> <li>▪ References in Heckman et al. (2010)</li> <li>▪ References in Belfield et al. (2015)</li> <li>▪ References in reviewed articles</li> <li>▪ References in non-reviewed articles</li> <li>▪ References from scholars who are active in the field</li> </ul> | <p>Searching additional references for specific methods and techniques applied in the cost-benefits analyses.</p> |
|---|---|

### Conferences and workshops

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>▪ Society for Benefit-Cost Analysis 11th Annual Conference &amp; Meeting</li> </ul> | <p>Searching for latest methodological advances and directions in the field.</p> <p>Applications of cost-benefit analyses in other fields.</p> <p>Communications with scholars active in the field.</p> |
|--|---|

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Note: This table describes our search for literature and methodological discussions from various sources.

## Bilag 2 Documentation of screenings and preliminary mappings

The literature synthesis consists of multiple stages. First, all potentially relevant studies were independently screened by two reviewers (Stage 1) and if they met the eligibility criteria proceeded to full abstract review and data extraction (Stage 2). In stage 3, studies were subjected to critical appraisal of the quality of the cost-benefit analysis provided. In stage 4, we synthesised and analysed the cost-benefit analyses to answer the research objective. Results: 1838 unique studies were identified at Stage 1, 1416 proceeded to Stage 2 and, following mapping and quality appraisal, 17 were included in the review.

### Screening 1

We double screened the results from the electronic database search to reduce the number of redundant studies that are clearly irrelevant. In case of discrepancy between the two screeners, studies are revised. The initial screening resulted in 387 irrelevant studies and 35 duplicate studies to be excluded; see Table A2.1.

The initial screening assessed title, keywords and abstracts. We used the following rules for selection:

Keep if:

i) Cost-benefit/cost-effectiveness/cost-analysis/willingness to pay or similar methods related to cost-benefit calculations are mentioned in the title, keywords or abstract.

AND

ii) Topic fields related to early childhood, education, schools, youth or similar programmes or interventions are mentioned in the title, keywords or abstract.

**Table A2.1** Screening 1: Results

Selection	No. of studies to be deleted	Total no. of studies for review
Database search Dec. 2017 (initial Refworks list)		1836
Screening 1		
Screening 1, Person A	306	
Screening 1, Person B	446	
Screening 1, Final (including medicine and clinical trials)	387	1451
Duplicates	35	1416

Note: This table shows the number of studies discarded in the first screening. We exclude studies in the following fields: Finance, environment and climate changes, terror, law, economic growth, migration, smoking, firm behaviour (cost), marketing, accounting, retirement, energy markets, health care sector (health care costs, cost control etc.), Migration (costs of brain drain, students' migration, etc.), immigration policy, Macro (economic growth, development, human capital, growth etc.), management (costs of training, firm policy etc.), human nature and life science, engineering and technology, sports injury and prevention programmes for youth sport, medicine (clinical trials).



## Mapping stage 1: Intervention field

The database search resulted in a broad range of studies from different fields. In the first mapping, we categorised fields of intervention: Early childhood, Education, Youth, Higher education, Health economics, Vaccination and disease prevention, and other (see definitions below).

We kept studies in the fields of early education (441 studies), education (353 studies) and youth (244 studies), see Table A2.2. After reading abstracts, we dropped studies from developing and low-income countries. We also give a brief assessment on whether a cost-benefit analysis is provided in the paper (no/unclear/yes).

**Table A2.2** Mapping 1: Field of intervention

Intervention field	No. of studies	Developing countries
Early childhood	435	42
Education	349	70
Youth	234	27
Other:		
Higher education	107	
Health economics	129	
Vaccination and disease prevention	104	
Other	58	
Total	<b>1416</b>	

*Early childhood programmes:* Includes programmes and interventions aimed at improving children's skills and life trajectories. Programmes are implemented in nurseries, day cares, child cares, family centres, home visiting programmes, pre-schools or kindergarten. The search also returned parent training programmes and programmes aimed at parents' labour supply (e.g. providing child care). In addition, we categorised according to the following topics:

- Children outside home care
- Child abuse and maltreatment
- Child benefits and income support
- Early childhood programmes (specific interventions)
- Health programme (incl. family planning, breastfeeding, nutrition)
- Intergenerational effects (e.g. from parents' education)
- Labour supply and child care
- Mental health and behaviour (e.g. children with ADHD)
- Methods
- Neighbourhood and poverty
- Parent training programmes
- Preschools and returns from pre-school and education
- Production of skills
- Other.

*Education programmes:* Includes education programmes in general as well as specific interventions target school-aged children, including

- Gender gaps in schooling and achievement
- School resources, school reforms, structural school policy, accountability etc.
- Teacher development
- Development of skills in school-aged children
- Impacts and return of schooling
- Levels: K1-12, schools, primary school, elementary schools, middle school, lower-secondary school, secondary school and high school.

*Youth programmes:* Includes programmes target at disadvantaged youth, including

- Training and interventions targeted at youths
- Transitions school – high school – higher education
- High school drop-out
- Teen-parents and sex-prevention strategies
- Criminal activity, drugs and alcohol
- Vocational education and training.

*Higher education:* Includes college, universities, undergraduates, tertiary, faculty programmes

- Training of, for instance, nurses, doctors, teachers, social services, care givers etc.
- Transition to higher education.

*Health:*

- Public health
- WHO interventions and guide dance
- Feeding programmes, nutrition
- Obesity in children and youths
- Medicaid, health insurance and health cover.

*Vaccination and disease prevention:* Includes cost-effectiveness studies of vaccination programmes and other disease-control programmes aimed at mothers or children in risk of HIV, tuberculosis, malaria etc.

*Other:* Other discussions about public policy spending on children and youth, including social policy, welfare policy, poverty and inequality.

## **Mapping stage 2**

We continued to extract more information about the studies. We categorised according to intervention field and type of publication to assess whether a cost-benefit analysis (CBA) is provided. We screened multiple times and downloaded papers for full-text reading (papers sorted in the categories yes or unclear).

The final results are reported in Table A2.4.

**Table A2.3** Mapping 2: Publication type and provision of cost-benefit analyses

Publication type	CBA provided?			
	Total	Yes	No	Unclear
<b>Programme evaluations:</b>				
Cost-benefit analyses	20	20	0	0
<ul style="list-style-type: none"> <li>▪ Describing the estimation of costs and benefits</li> <li>▪ Reporting CB ratio</li> </ul>				
Cost-savings analyses and cost-estimation:	22	11	6	5
<ul style="list-style-type: none"> <li>▪ From the perspective of the government, using state administrative data</li> <li>▪ Provides examples on how to calculate state-level or public sector costs</li> <li>▪ Examples of how to collect data</li> </ul>				
Policy and/or research briefs	39	2	26	11
<ul style="list-style-type: none"> <li>▪ Discussion of evidence and policy, summarising previous cost-benefit analyses but no independent cost-benefit calculations or methodological contributions</li> </ul>				
Impact evaluations	57	0	57	0
<ul style="list-style-type: none"> <li>▪ Experimental or quasi-experimental studies trying to identify a causal effect; no monetising of benefits and costs</li> </ul>				
Cost-effectiveness analyses (CEA)	21	18	3	0
<ul style="list-style-type: none"> <li>▪ Reporting the cost-effectiveness of a programme</li> <li>▪ Monetisation of costs but not benefit</li> </ul>				
<b>Methods:</b>				
Methodological papers about cost-benefit frameworks of early childhood interventions:	12	1	2	0
<ul style="list-style-type: none"> <li>▪ Describing frameworks or specific methodological techniques (e.g. discounting, uncertainty, willingness-to-pay estimations)</li> </ul>				
Policy models or resources	10			
<ul style="list-style-type: none"> <li>▪ Describing public policy models or databases (like the WSIPP model (US) or SØM (DK))</li> <li>▪ Describing other models to estimate the fiscal cost savings from public spending on children</li> </ul>				
Book or collection of articles	7			
<b>Other:</b>				
Observational studies (correlation studies, descriptive studies, risk factors)	48			
Qualitative studies including case studies and implementation fidelity	47			
Literature reviews and meta-analyses of evidence	25			
Life-cycle or structural models (simulation, OLG, matching, theory etc.)	21			
Clinical trials and research protocols	11			
Questionnaires (surveys, assessment and diagnostic)	7			
Other (discussions, perspectives and theories not related to cost-benefit analysis)	44			
<b>Total</b>	<b>390</b>			

Note: This table reports the final search results after mapping by publication type and provision of a cost-benefit analysis.

### Mapping stage 2: To identify studies with a cost-benefit analysis

We continued with those studies that included a cost-benefit analyses (if “yes” or “unclear” in Table 4).

Key, basic information about the publication, intervention, participants and outcomes was extracted and tabulated. We also extracted and tabulated information about the cost-benefit analysis: years of follow-up, benefit domains included, costs collection method etc. The aim was to identify studies including a full cost-benefit analysis and a solid description of methods.

#### *Study information*

- Authors, Title, Keywords, Abstract and link (from Refworks)
- Programme name
- Intervention field: Early childhood/Education/Youth
- Study population: Country (US/Western/Developing/Unknown)
- Publication type: Multiple categories
- Cost-benefit analysis provided: yes/unclear/no (based on abstract-screening).

#### *Information about the cost-benefit analysis, quality assessment:*

- Years of follow-up
- Cost-benefit rate reported: no/unclear/yes/yes, including sensitivity tests
- Internal rate of return: no/unclear/yes/yes, including sensitivity tests
- Description of benefits included: no/unclear/yes
- Description of costs included: no/unclear/yes.

#### *About benefits (if provided):*

- Within-sample interpolation to future outcomes: no/unclear/yes
- Out-of-sample extrapolation to future outcomes: no/unclear/yes
- Benefit domains included: cognitive, socio-emotional behaviour, education, economics, health and family, crime, social policy

#### *About costs (if provided):*

- Cost method: Ingredient method/programme costs only/other
- Costs domains included: programme costs, administrative costs, education costs, economic costs and savings, shadow prices, incremental costs

### **Mapping stage 3: Quality appraisal of final cost-benefit analyses**

We continue with those studies that conduct a full cost-benefit analysis (where publication type = single or multiple cost-benefit analyses).

We extract information about methods related to the estimation of costs and benefits. The aim was to synthesise and tabulate information about methods in the review, and to identify studies that apply state-of-the-art methods or otherwise contribute methodologically.

#### *About methodology and contributions:*

- Overall score of method quality (1 low/2 medium/3 high)
- Cost description (open ended)
- Methodological contribution (open ended)
- Effect estimator (e.g. ATE, ATT etc.) (discarded)
- Source of identification (e.g. RCT, RD, matching, etc.)

- Age at last observed follow-up data (type number)
- Projected benefits at age (type number)
- Apply lifetime projections (yes/no/unclear)
- Effect on low-income or otherwise at-risk groups analysed separately (open ended)
- Discuss discounting (yes/no/unclear)
- Discuss uncertainty or standard errors (yes/no/unclear)
- Discuss methods for missing data/imputation methods (yes/no/unclear)
- Sensitivity analyses (open ended)
- Suggested action (include in/exclude from review).

## Bilag 3 Illustrations of development in cost-benefit analyses

**Table A3.1** Development in cost-benefit analyses of HighScope Perry Preschool Program

Papers	Robustness and discussion	Age (Observed)
Barnett 1985	Original CBA	Preschool
Schweinhart et al. 1993	Age 27 follow-up CBA	27
Barnett 1996	Age 27 follow-up CBA	27
Rolnik and Grunewald 2003	Age 27 follow-up CBA CBA based on estimates from Schweinhart 1993	27
Schweinhart et al. 2005	Age 40 follow-up CBA	40
Belfield et al. 2006	Age 40 follow-up CBA Observe and monetise the following benefit domains: Education costs Welfare costs Earnings and taxes Crime	40
Heckman et al. 2010*	Thorough cost-benefit analysis that monetise outcomes observed at age 40 and extrapolate out of the sample to future outcomes at age 65.  a) Adjusts for compromised randomisation and small sample sizes b) Develops procedure for bootstrap and permutation test of standard errors to address uncertainty and small sample sizes. c) Discusses and tests assumptions about deadweight loss from taxation d) Discusses and tests assumptions about discount rates e) Discusses and tests different techniques: Impute within-sample missing data e) Discusses and tests different techniques: Extrapolation out of the sample f) Uses local cost data instead of national cost data to obtain more accurate costs	65
Schweinhart et al. 2016*	Age 40 follow-up CBA with particular focus on benefits in terms of reducing crime.  Observed benefit domains (refer to earlier studies): Education costs Welfare costs Earnings and taxes Crime  The paper illustrates a causal model to understand the pathways from early childhood programmes to long-term benefits on crime outcomes. The model includes improvements on IQ, and the authors discuss the test score fade-out in relation to this.	40

General note: This table reports cost-benefit analyses of the Perry Preschool Program (PPP), including description of the methodological development.

Note: \*: Cost-benefit analysis identified in our literature search.

Source:

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**Table A3.2** Development in cost-benefit analyses of Chicago Child-Parent centers (CPC)

Development in methods		Age (Observed)
Institute for Research on Poverty University of Wisconsin–Madison (IRP) <sup>1</sup>	The first cost-benefit analysis, reports the net present value for: preschool age programme, school-age programme, and the extended programme.  They include the following benefits (cost savings): - reductions in expenditures for school remedial services - reductions in criminal justice system expenditures - reductions in child welfare system expenditures - averted tangible costs for victims of crime and child maltreatment - increased earnings capacity of programme participants and tax revenues.	Preschool Ages 3-9
Reynold and Temple 1998	Based on Chicago Longitudinal Study (CLS) 1999  Observe and estimate education benefits and costs using special education but no reporting of cost-benefit ratios.	Age 13
Reynolds et al. 2001	Age 15 follow-up CBA. Observe and monetise the following domains: Education	15
Reynolds et al. 2002	Age 21 follow-up CBA.  Observe and monetise the following domains: Education Earnings Crime	21
Temple and Reynolds 2007	Age 24 follow-up CBA.  Observe, monetise and project the following domains: Education, Earnings, and Crime.  Methodological developments in terms of: a) Discuss and tests discount rates b) Assumptions about crime benefits, which are included and monetised c) Re-estimate regression models with alternative model spec. d) Assumptions about lifetime earnings by subgroups (directly measured vs. projected by group differences in educational attainment)  Furthermore, they discuss mechanisms and pathways from primary impacts to long-term impacts.	24
White et al. 2010*	Discuss <i>ex-ante</i> versus <i>ex-post</i> crime projections.  Compare projection results from earlier studies (projecting from data observed at age 21) to updated data with observed outcomes at age 27.	27
Reynolds et al. 2011*	Age 26 follow-up CBA.  Observed and monetise long-term benefits on earnings and crime. Including: - Projections of earnings to age 65 - Discuss discounting and uncertainty using Monte Carlo simulations - Discuss attrition	26



Development in methods		Age (Observed)
	<ul style="list-style-type: none"> <li>- Sets up a 5-hypotheses model to understand long-term benefits</li> <li>- Robustness tests to account for the above.</li> </ul>	

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