



Department
for Education

Study of Early Education and Development (SEED): The potential value for money of early education

Research report

July 2017

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**Study of Early Education
& Development**



Social Science in Government

Acknowledgments

We would like to thank the SEED research teams at NatCen Social Research, 4Children and Oxford University for their assistance to this component of the evaluation. We are also grateful to Maura Lantrua, Allan Little, Max Stanford and Rachel Jones at the Department for Education and to the SEED Advisory Board for comments and advice throughout the work.

Contents

List of figures	5
List of tables	6
Executive Summary	8
1. Introduction	12
2. Methodological Approach	14
2.1 Structure of the value for money analysis	14
2.2 Selecting evidence sources	16
2.3 Calculating the value of impacts	16
2.4 Caveats	17
3. The value of improving child development at ages three and four	20
3.1 Associations between child development at age three and later outcomes	20
3.2 The monetary value of later outcomes	26
3.3 The value of improving early outcomes	29
3.4 Summary	31
4. The value of improving Key Stage 1 attainment at age seven	32
4.1 The NPD sample	32
4.2 Associations between KS1 attainment and later outcomes	34
4.3 The monetary value of later outcomes	36
4.4 The value of improving KS1 attainment	38
4.5 Summary	39
5. Cost benefit breakeven analysis	40
5.1 Costs of delivering early education	40
5.2 Breakeven impacts for early education	41
5.3 Variation in breakeven impacts across types of provision	45

5.4	Summary	48
6.	Conclusions	49
	References	51
	Annex A: Descriptions of cognitive and social development measures	55
A.1	BAS naming vocabulary at ages 3 and 5	55
A.2	MCS cognitive scores at ages 5 and 7	55
A.3	English picture vocabulary test at age 5	55
A.4	NCDS cognitive skills measure at age 7	55
A.5	Edinburgh reading test and Bristol Friendly maths test at age 10	56
A.6	NFER-Nelson reading test and NFER-Nelson maths test at age 10	56
A.7	SDQ total difficulties score at ages 3, 5 and 7	56
A.8	BSAG social skills score at age 7	57
	Annex B: Regression results for main NPD analysis	58
	Annex C: Results for alternative specifications	63
	Annex D: Description of provider type and quality	66

List of figures

Figure 1: Summary of the structure of the value for money analysis	14
Figure 2: Links from BAS at age 3 to later outcomes	24
Figure 3: Links from SDQ at age 3 to later outcomes	25

List of tables

Table 1: Estimated value of improving child development at ages three and four	9
Table 2: Estimated value of improving KS1 attainment at age seven	10
Table 3: Breakeven impacts for total value for money	11
Table 4: Evidence sources for the associations between child development at age three and later outcomes	21
Table 5: Associations between child development at age three and later outcomes	22
Table 6: The monetary value of later outcomes	28
Table 7: Estimated value of improving child development at ages three and four	30
Table 8: Summary statistics for KS1 attainment in the NPD	33
Table 9: Summary statistics for later outcomes in the NPD	34
Table 10: Associations between KS1 attainment and later outcomes	35
Table 11: Average simulated gross lifetime earnings by qualification level	37
Table 12: Estimated value of improving KS1 attainment	38
Table 13: Costs of delivering early education	41
Table 14: Example benefit to cost ratio calculations	42
Table 15: Breakeven impacts for total value for money	44
Table 16: Breakeven impacts for Government value for money	45
Table 17: Variation in breakeven impacts across types of provision: two year olds	46
Table 18: Variation in breakeven impacts across types of provision: three year olds	47
Table 19: NPD regression results for number of years of SEN	58
Table 20: NPD regression results for number of years of persistent truancy	59
Table 21: NPD regression results for probability of school exclusion	60
Table 22: NPD regression results for highest qualification	61
Table 23: NPD regression results for highest qualification with interactions	62
Table 24: Associations with alternative KS1 specifications: SEN	63

Table 25: Associations with alternative KS1 specifications: truancy	63
Table 26: Associations with alternative KS1 specifications: exclusion	64
Table 27: Associations with alternative KS1 specifications: highest qualification	64
Table 28: Associations with alternative highest qualification specification	65

Executive Summary

This report is the second output from the value for money component of the Study of Early Education and Development (SEED). The value for money component of SEED will compare the costs of delivering early education with the monetary value of the impacts on child development. Value for money will be captured in the “benefit to cost ratio”¹ and this will be estimated for different types of provision (part-time and full-time², provider type and quality of provision).

The first report from the value for money component (Blainey & Paull (2017)) provided the required cost information using data collected from 166 settings delivering early education in 2015 and later analysis from SEED will provide estimates of the impacts on child outcomes at ages three, four and seven. Prior to the estimation of actual impacts, this report identifies the level of impacts required to achieve positive value for money (the “breakeven impacts”) by combining the cost data with estimates of the monetary value of impacts derived from existing evidence and from new analysis of the National Pupil Database (NPD). Estimation of these breakeven impacts provides early insights into whether positive value for money is feasible and into the variation in the size of the breakeven impacts across different outcomes and types of provision.

Estimates of the value of the benefits of impacts are derived using two steps. First, current evidence is used to link measures of child development at age three and four with later lifetime outcomes and new analysis of NPD data is used to link school achievement at age seven with later lifetime outcomes. Second, existing evidence on the monetary value of improving later outcomes is used to estimate a value for a standardised change (one standard deviation) in the initial outcomes at ages three, four and seven.

The existing evidence shows that improvements in child development at age three and age four can be linked to later monetary benefits from reduced Special Educational Needs (SEN), truancy, school exclusion, crime, smoking and depression and from improved employment rates and earnings. The new analysis of NPD data shows that improvements in Key Stage 1 (KS1) attainment at age seven can be linked to later monetary benefits in reduced SEN, truancy and school exclusion and from higher qualifications leading to higher lifetime earnings.

The values of changes in later outcomes associated with the changes in initial outcomes at ages three, four and seven are presented in tables 1 and 2. The values of similar sized

¹ The benefit to cost ratio is the value of the benefits divided by the cost. If this ratio is greater than one, the estimated value of the benefits exceeds the cost and early education can be said to offer positive value for money.

² In this report, part-time early education is defined as 15 hours per week for 38 weeks and full-time early education as 30 hours per week for 52 weeks.

improvements in cognitive development (measured as the BAS naming vocabulary score) and social development (measured as the Strengths and Difficulties Questionnaire total difficulties score) at age three or age four are quite similar: a change in these outcomes of a standard deviation is estimated to have a monetary value of around £8,000 (table 1).³ Such changes correspond to around 17 points on the BAS scale (which ranges from 10 to 141) or around 5 points on the SDQ scale (which ranges from 0 to 40). An improvement of a standard deviation in KS1 attainment at age seven (measured as the total points in all KS1 subjects) is estimated to have a monetary value of around £60,000 (table 2). Such a change corresponds to a 3 point increase in the KS1 score across all subjects (which ranges from 5 to 20).

Table 1: Estimated value of improving child development at ages three and four

Value per child of associated difference in final outcomes (beneficiary)	1 standard deviation increase in BAS		1 standard deviation decrease in SDQ	
	Age 3	Age 4	Age 3	Age 4
Lower SEN, truancy, exclusion, crime, depression (govt)	£265	£275	£307	£319
Lower smoking (govt)	£27	£28	- £91	- £94
Lower smoking (private)	- £72	- £75	£248	£257
Lower smoking (society)	- £32	- £33	£108	£112
Higher employment (govt)	£579	£600	£1,215	£1,259
Higher employment (private)	£899	£932	£1,887	£1,955
Higher wage (govt)	£1,910	£1,979	£882	£913
Higher wage (private)	£4,868	£5,043	£2,246	£2,327
Total govt	£2,781	£2,881	£2,303	£2,386
Total private	£5,695	£5,900	£4,381	£4,539
Total society	- £32	- £33	£119	£123
Grand total	£8,444	£8,748	£6,803	£7,048

Notes: Private indicates benefits or costs accruing to private individuals (the children experiencing early education), Govt indicates those accruing to the Government (through increased revenues or reduced spending on services other than early education) and society indicates those accruing to society more broadly (other individuals who did not use the early education). A decrease in the SDQ total difficulties score corresponds to an improvement in social development.

³ The values of impacts are estimated for a standard deviation change in each initial outcome because it allows the value of a similar size of impact to be compared across outcomes with different metrics. The standard deviation is a measure of the variation in the outcome and, in most cases, 68 percent of individuals will have a value of the outcome which lies within one standard deviation of the mean.

Table 2: Estimated value of improving KS1 attainment at age seven

Value per child of associated difference in final outcomes (beneficiary)	3 point (1 standard deviation) increase in KS1 attainment at age seven
Reduction in number of years with SEN (govt)	£3,916
Reduction in number of years with truancy (govt)	£17
Reduction in probability of exclusion (govt)	£250
Higher earnings from higher qualifications (govt)	£15,681
Higher earnings from higher qualifications (private)	£39,962
Total govt	£19,864
Total private	£39,962
Grand total	£59,826

Notes: see notes to table 1.

The key driver of the monetary value of the returns is higher earnings rather than reductions in the costs of Government services and the benefits mainly accrue to individuals. This is partly because the links to later employment and earnings tend to be stronger than to other later lifetime outcomes. But it is primarily due to the fact that a small impact on earnings operates on high annual amounts for a large number of years for most individuals, while impacts which reduce “problem” outcomes (such as SEN, truancy, school exclusion, crime, smoking and depression) have an effect on a much smaller number of individuals over fewer years and with lower annual amounts involved.

Table 3 combines the estimated value of changes in initial outcomes with the estimated delivery costs from the previous SEED report for part-time (15 hours for 38 weeks) early education at age two and at age three to present the breakeven impacts. The breakeven impact is derived by dividing the cost by the value of a one standard deviation change in the outcome.

The lower cost at age three and slightly higher value of impacts at age four mean that the breakeven impacts are slightly lower for early education at age three than at age two for all three measures. For child development outcomes at ages three and four, the breakeven impacts lie in the range of what might be classified as “small” to “medium”, while those for the KS1 scores lie in the range of “very small” to “small”.⁴ However, it

⁴ Sawilowsky (2009) suggests that changes of 0.01, 0.2, 0.5, 0.8, 1.2 and 2.0 of a standard deviation might be classified as “very small”, “small”, “medium”, “large”, “very large” and “huge” respectively.

should be noted that impacts at age seven may be smaller than at the earlier ages if the effects fade over time. On the other hand, the effects could grow larger over time if immediate impacts on other factors such as child health and the home learning environment have later effects on educational achievement. In all cases, the breakeven impacts are within the range of the metric for each outcome.

Table 3: Breakeven impacts for total value for money

	Delivery cost per child	Value of an impact of 1 standard deviation	Breakeven impacts where benefit = cost	
			In standard deviations	In outcome metric
Part-time early education at age two				
Increase in BAS at age three	£2,451	£8,444	0.29	4.99
Reduction in SDQ at age three	£2,451	£6,803	0.36	1.78
Increase in KS1 score at age 7	£2,451	£59,826	0.04	0.12
Part-time early education at age three				
Increase in BAS at age four	£2,120	£8,748	0.24	4.17
Reduction in SDQ at age four	£2,120	£7,048	0.30	1.49
Increase in KS1 score at age 7	£2,120	£61,920	0.03	0.10

Notes: The BAS measure has a range of 10 to 141 with an estimated mean value of 74.35 and standard deviation of 17.19 and the SDQ measure has a range of 0 to 40 with an estimated mean value of 8.9 and standard deviation of 4.94 (Washbrook (2010), table 2.4)). The KS1 score has a range of 0 to 20 with an estimated mean value of 10.42 and standard deviation of 2.948 (table 8 below).

Differences in the breakeven impact levels across different types of provision are directly proportional to the differences in cost. For example, the breakeven impacts for all of the outcome measures for full-time early education (defined here as 30 hours per week for 52 weeks) are 2.7 times greater than those for part-time early education (defined here as 15 hours per week for 38 weeks) because the cost for 1,560 hours each year is 2.7 times greater than the cost for 570 hours each year. Hence, full-time early education would need to have considerably larger impacts than part-time early education to offer better value for money. However, the cost differences are much smaller across different types of provider and across different levels of quality of provision and the higher cost options would not require substantially greater impacts to mean that they offer better value for money.

1. Introduction

This report is part of the Study of Early Education and Development (SEED), an eight year study commissioned by the Department for Education to explore how childcare and early education can give children the best start in life and the factors which are important for the delivery of high quality provision.⁵ The study is being undertaken by NatCen Social Research, the University of Oxford, 4Children and Frontier Economics and is due to be completed in 2020. The aim of SEED is to provide a robust evidence base to inform the development of policy to improve children's readiness for school by:

- Providing evidence of the impact of current early years provision on children's outcomes and a basis for the longitudinal assessment of the impact on later attainment.
- Assessing the role and influence of the quality of early education provision on children's outcomes.
- Assessing the overall value for money of early education and the relative value for money associated with different types (e.g. private, voluntary, maintained) and quality of provision.
- Exploring how parenting and the home learning environment interacts with early years education in affecting children's outcomes.

To address these aims, SEED has several inter-related research elements:

- A longitudinal survey of that initially included 5,642 families with preschool children from the age of two to the end of key stage 1 (age seven).
- Around 1,000 visits to early years settings and to around 100 childminders to study the quality, characteristics and process of provision.
- Case studies of good practice in early years settings.
- A value for money study involving the collection of cost data from 166 settings.
- Qualitative studies of childminders and of early education provision for children with special educational needs and disabilities (SEND).

The value for money component of SEED will compare the costs of delivering early education with the monetary value of the impacts on child development. Value for money

⁵ Further information about the SEED study can be found at <http://www.seed.natcen.ac.uk/> and reports published to date are available at <https://www.gov.uk/government/collections/study-of-early-education-and-development-seed>.

will be captured in the “benefit to cost ratio” which is the value of the benefits divided by the cost. If this ratio is greater than one, the estimated value of the benefits exceeds the cost and early education can be said to offer positive value for money. The benefit to cost ratio will be estimated for different types of provision (part-time and full-time, provider type and quality of provision).

This is the second report from the value for money component. The first report (Blainey & Paull (2017)) provided the required cost information using data collected from 166 settings delivering early education in 2015 and later analysis from SEED will provide estimates of the impacts on child outcomes at ages three, four and seven. Prior to the estimation of actual impacts, this report identifies the level of impacts required to achieve positive value of money (the “breakeven impacts”) combining the cost data with estimates of the monetary value of impacts derived from existing evidence and from new analysis of the National Pupil Database (NPD). Estimation of these breakeven impacts provides early insights into whether positive value for money is feasible and into the variation in the size of the breakeven impacts across different outcomes and types of provision.

It should be noted that SEED only considers the impacts of early education on child development and school attainment. Other potential impacts, such as on health outcomes or on the home learning environment (HLE), are captured to the extent that impacts on child development can lead to later effects on these outcomes or if immediate impacts on HLE are captured in later school achievement. In addition, SEED does not consider the impacts of Government provision of free early education on parental employment which could generate additional monetary value. Previous evidence on the impacts of free early education for three year olds on parental employment suggests that the impacts are not large for this age of child (for example, see Brewer et al (2016) or Paull and Xu (2015)).

The remainder of this report is structured as follows:

- Chapter two describes the methodological approach used to estimate the value for money and the caveats involved.
- Chapter three presents the estimates of the monetary value of improving child development at ages three and four using evidence from the existing literature.
- Chapter four presents the estimates of the monetary value of improving school achievement at age seven using new analysis of the National Pupil Database and evidence from the existing literature.
- Chapter five combines these estimates with the delivery costs from the earlier report to analyse the breakeven points for impacts at ages three, four and seven.
- Chapter six summarises the key findings.

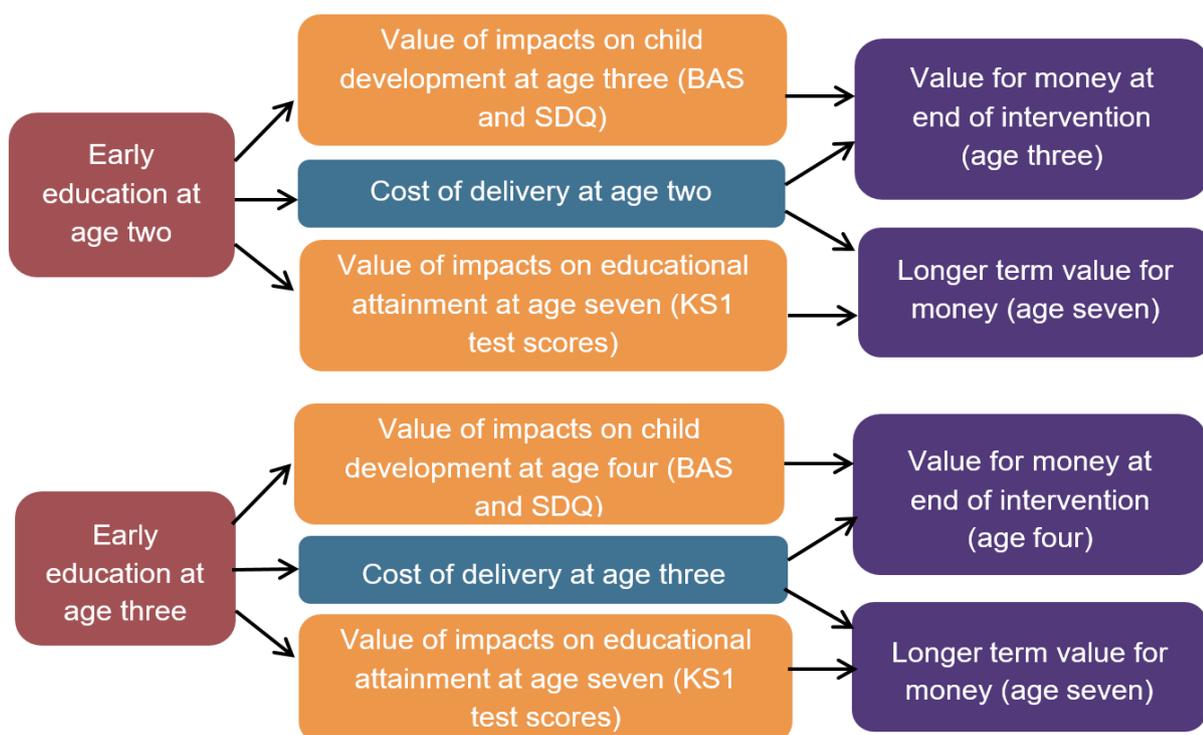
2. Methodological Approach

This chapter describes the methodological approach taken to estimate the potential value for money of early education. The first section describes the structure of the analysis, presenting the measures used and how they feed into the estimation of value for money. The second section presents the criteria for the selection of evidence sources for estimating links with later outcomes and their monetary values, while the third describes some technical aspects of calculating the value of impacts. The final section presents some caveats on the methodology and resulting estimates.

2.1 Structure of the value for money analysis

Figure 1 summarises the structure of the value for money analysis and the early education and outcome measures considered.

Figure 1: Summary of the structure of the value for money analysis



The SEED study will consider the potential impacts of early education for all ages of pre-school children and for a range of outcomes at ages three, four (just prior to school entry), five and seven. In order to focus on the value for money of the free early education entitlement which is offered to all three and four year old pre-school children and to two year olds from disadvantaged families, the analysis only considers early

education at age two and at age three.⁶ It also examines two points of impact: immediately after the intervention (at age three for two year old early education and at age four just prior to school entry for three year old early education) and a later measure (at age seven for both) to consider whether the value for money changes over time as impacts either take time to materialise or initial impacts fade out over time.

This report considers two outcomes for children at ages three and four:

- Child’s cognitive development measured by the naming vocabulary assessment from the British Ability Scale III (referred to simply as “BAS” in this report).
- Child’s behaviour measured as the total difficulties score from the Strengths and Difficulties Questionnaire (referred to simply as “SDQ” in this report).

The choice of these outcomes is driven by a combination of the measures collected in the SEED study which will be analysed in the impact strand and the availability of evidence to link impacts on outcomes at this age to later lifetime outcomes which can be valued in monetary terms. Two other measures collected in SEED at ages three and four were considered for inclusion in the value for money analysis, but have not been used for the following reasons:

- The SEED impacts analysis may include an additional BAS measure of picture similarities but this is not used here because the evidence linking BAS outcomes at ages three and four to later outcomes is only available for the naming vocabulary assessment.
- The SEED impact analysis may include an additional measure of cognitive development at age four in the “Heads, Toes, Knees and Shoulders” (HTKS) assessment but this is not used here because there is little evidence linking HTKS at age four to later outcomes.

This report considers one outcome measure at age seven:

- National tests of Key Stage 1 (KS1) attainment as reported in the National Pupil Database (NPD).

This choice is driven by the fact that impact at age seven will be tested in SEED using data from the NPD linked to children in the SEED study. Consideration was also given to including measures of SEN, truancy and exclusion at age seven. However, the truancy measure is not available in the NPD data at age seven and almost no children are excluded by the age of seven (so any impacts would be negligible). Instead, the impacts

⁶ This could be extended to explore the value for money for a combination of early education at ages two and three if the later impact analysis identifies this combination as having significant impacts.

of early education on these outcomes (SEN, truancy and exclusion) after age seven have been modelled via the impact on KS1 attainment.

2.2 Selecting evidence sources

Several principles were applied in selecting the evidence sources used to estimate the links between immediate and longer outcomes and in estimating a monetary value for the final outcomes:

- All evidence was from the UK. For the links, this was required not only in order to match the initial outcome measures but also to ensure that the contextual factors influencing the links were the most relevant ones. For monetisation, it was important to match UK costs of delivering early education with UK valuations of benefits.
- Only statistically significant relationships from regressions which included controls for other related factors were used to estimate the links. This was to help ensure that the links used are those most likely to represent a causal relationship rather than a simple correlation so that a change in the initial outcome could be considered as driving a change in the later outcome.
- Single links over longer time periods were used in preference to multiple, shorter links covering the same connections. Using fewer and more direct links generally identified stronger and more robust associations by reducing the accumulated sampling variation and minimizing the need to convert measures to similar alternatives at some ages.
- Evidence was selected to avoid double-counting in the final valuations, either through multiple chains of links leading to the same outcome or through monetary valuations of one outcome including the value of other outcomes. The most prevalent example of this was the exclusion of the value of impacts on earnings in the valuation of other outcomes (such as crime or depression) because the impact on earnings was measured directly.

In practice, the range of appropriate sources of evidence was quite limited and there were few choices in selecting the sources that were used.

2.3 Calculating the value of impacts

Two steps were taken to allow the estimated value of the impacts to be comparable to the measured cost:

- All historical prices and valuations were indexed to 2015 using HM Treasury GDP deflators (HM Treasury (2015)) to match the cost data which was collected in 2015.
- Following the standard approach to value for money analysis, the monetised value of all benefits were discounted back to the time of the impact, when the child was age three or age four. This is to allow for the fact that £1 in the future is worth less than £1 today. A discount rate of 3.5 percent was applied for the first 30 years after the intervention and 3 percent thereafter for up to 75 years following the intervention, in line with HM Treasury guidance (HM Treasury (2003)).

To calculate the total value for money, the values of all immediate and subsequent impacts were summed for each initial outcome (with the avoidance of double counting as described in the previous section). However, the analysis considers two outcomes (BAS and SDQ) at ages three and four and there is no straightforward approach to how the value of these should be combined given that they impact similar later outcomes. If the impacts on the two initial outcomes are completely independent (i.e. the impacts on BAS and SDQ affect different children or they have independent effects on later outcomes if they affect the same children), the values for both initial outcomes can simply be summed together. For example, if a child has higher earnings because BAS is higher age three and *additional* higher earnings if SDQ is also higher, the value can be the sum of both increases in earnings. However, if the impacts of the two initial outcomes are closely related (i.e. every child with an impact on BAS has a related impact on SDQ), the value of the outcomes should not be summed. For example, a child may have higher earnings potential partly due to higher BAS and partly due to higher SDQ. In this case, summing the two values would double-count the total benefit. Without evidence on the correlation of impacts (and not just of the measures themselves), it is not possible to identify the degree to which the value of impacts can be summed across initial outcomes. Therefore, in this report, the two outcomes are considered separately.

Finally, the values of impacts are estimated for a standard deviation change in each initial outcome. The standard deviation is a measure of the variation in the outcome and, in most cases, 68 percent of cases will have a value of the outcome which lies within one standard deviation of the mean. Using the standard deviation allows the value of a similar size of impact to be compared across outcomes with different metrics. It is also convenient because much of the cited literature presents links in terms of associations in standard deviations. However, it should be noted that an impact of one standard deviation would generally be considered a large change.

2.4 Caveats

Several important caveats should be noted about this methodology and the resulting value for money estimates.

First, there is a considerable degree of approximation in drawing on related but not necessarily ideal evidence to derive the links between immediate outcomes and later lifetime outcomes. For example, the relationship used to link the reading test at age ten with the probability of SEN at age ten is based on the EPPE sample of children which is not representative of all children of this age.

Second, there is an implicit assumption that there is no “fade-out” in impact. That is, any initial impact is assumed to have the same impact on later outcomes as another factor currently driving variation in the initial outcome. For example, if a higher BAS score at age three is associated with higher lifetime earnings, it is implicitly assumed that any impact of early education on BAS will have the same size of effect on earnings. However, it may be the case that because the intervention (early education) has ended, the impacts may diminish over time as outcomes are increasingly related to experiences in years without the intervention. Given that the links used in this report are derived from evidence based on regressions controlling for other observed factors, some allowance has been made for fade-out by recognizing that these other factors which explain some of the variation in the initial outcomes will continue to drive variation in outcomes in later years. However, to the extent that regression analysis cannot completely control for all unobserved drivers, there is a possibility that there will be some fade-out in impacts which is not allowed for here.

Third, the estimates are based on point estimates of mean values for all costs, benefits and other parameters without consideration of the sampling variation. Incorporation of the variation for all elements of the value for money models would not be useful because the resulting confidence intervals would be too broad to be meaningful. Nor is calculation of the confidence intervals feasible because the literature sources do not always provide the required information.

Fourth, and perhaps most seriously, the value of the impacts may be understated because the existing evidence does not cover all links to later outcomes and provide adequate measures of the monetary values of outcomes. The potential candidates for under-counting of the value of the impacts can be assessed:

- There are links between SDQ and physical health at age 42 and between higher educational attainment and physical health which have not been included because suitable sources of monetary value with quantifiable links could not be identified. However, noting that the earnings benefit is already counted directly, the value of improved physical health is likely to be of a similar magnitude to that for the reduced costs for other services. In addition, some of the value of improved physical health has been captured in the benefits of reduced smoking. Overall, the value of these omitted benefits is unlikely to be large.
- Intergenerational links may exist between improved adult outcomes, better parenting skills and improved outcomes for their children, but evidence for these links has not been identified. However, the value of the effects on future

generations would be reduced by the need to discount the benefits by at least twenty years and by the addition of inter-generational links in outcomes. Hence, the value of these omitted benefits is also unlikely to be large.

Finally, it should be reiterated that SEED only considers impacts on child development. Other impacts on the child or on parental employment which could potentially add to the value of the benefits of early education have not been considered here.

3. The value of improving child development at ages three and four

This chapter describes the estimation of the monetary value of improving child development at ages three and four using evidence from the existing literature. The first section describes the links between the initial outcomes in the SEED study and later lifetime outcomes for which estimates of monetary value can be derived. The second section presents the derivation of the estimates of monetary costs or benefits for these later outcomes and notes whether these accrue to the Government, private individuals or society more broadly. The third section combines the links and monetary values of final outcomes to derive an estimate of the value of a one standard deviation improvement in each initial outcome. The final section summarises the findings.

3.1 Associations between child development at age three and later outcomes

The SEED study will consider the potential impacts of the use of early education at ages two and three on the following outcomes:

- Child’s cognitive development measured by the naming vocabulary assessment from the British Ability Scale III at ages three and four (referred to simply as “BAS” in this report).
- Child’s behaviour measured as the total difficulties score from the Strengths and Difficulties Questionnaire at ages three and four (referred to simply as “SDQ” in this report).

While these outcomes have no immediate monetary value, existing evidence on the relationships with later lifetime outcomes can be used to link any impacts on the initial outcomes to later effects which do have monetary value.

Table 4 presents a summary of the evidence sources used to estimate these links. For this section, only initial outcomes at age three are considered and the findings are extended to initial outcomes at age four in section 3.3. The initial three sources in the table present estimated links between child development at age three and development at subsequent ages up to age ten, while the last two sources present estimated links from development measures at ages seven and ten to other types of outcomes from age ten into adulthood for which monetary valuations can be derived.

The evidence sources presented in table 4 can be regarded as reasonably robust. The data used in the studies are nationally representative samples of children from the UK, with the exception of the EPPE data which primarily (90 percent) consists of children who were selected because they were attending a pre-school centre at age three in 1997. Given the purpose of analysing links with later lifetime outcomes, it is not surprising that

the studies tend to analyse older cohorts of children (those born in 1958 for the NCDS, 1970 for the BCS and 1994 for EPPE), while the studies using the MCS consider a more recent cohort (those born in 2000/2001). Complete details about the studies can be found in the original references.

Table 4: Evidence sources for the associations between child development at age three and later outcomes

Source	Sample	Associations: initial outcome ⇒ later income
Cullis & Hansen (2008)	8,000 children in England from wave 3 (age 5) of the MCS	Tables 3 and 6: <ul style="list-style-type: none"> BAS and SDQ at age 3 ⇒ BAS and SDQ at age 5
Sullivan et al (2010)	11,000 children in the UK from wave 4 (age 7) of the MCS	Tables A3 and A5: <ul style="list-style-type: none"> MCS cognitive score at age 5 ⇒ MCS cognitive score at age 7 SDQ at age 5 ⇒ SDQ at age 7
Feinstein & Duckworth (2006)	1,700 children in Britain from wave 3 (age 10) of the BCS	Table 4: <ul style="list-style-type: none"> English picture vocab. test at age 5 ⇒ Edinburgh reading test at age 10 and Bristol Friendly maths test at age 10
Carneiro et al (2011)	10,000 children in Britain from waves 4 (age 16) and 7 (age 42) of the NCDS	Tables 4.1, 4.3, 4.5: <ul style="list-style-type: none"> NCDS cognitive skills and BSAG social skills at age 7 ⇒ truancy, exclusion, youth crime and smoking by age 16; crime, depression, employment and hourly wage at age 42
Anders et al (2011)	2,500 children in England from wave 3 (age 11) of EPPE	Pages 431/435 + SEN proportions on page 429: <ul style="list-style-type: none"> NFER-Nelson reading test at age 10 ⇒ SEN in reading at age 10 NFER -Nelson maths test at age 10 ⇒ SEN in maths at age 10

Notes: MCS is the Millennium Cohort Study; BCS is the 1970 British Cohort Survey; NCDS is the National Child Development Study and EPPE is the Effective Pre-School and Primary Education study.

Table 5 presents the size of the links reported in these studies. Corresponding to table 4, the initial five rows present estimated links between child development at age three and development at subsequent ages up to age ten, while the remaining rows present estimated links from development measures at ages seven and ten to other types of outcomes from age ten into adulthood.

Table 5: Associations between child development at age three and later outcomes

Initial Outcome	Later outcome	Associated change with 1 standard deviation increase in initial outcome
BAS at age 3	BAS at age 5	+ 0.25 s.d.
SDQ at age 3	BAS at age 5 SDQ at age 5	- 0.02 s.d. + 0.55 s.d.
MCS cognitive score at age 5	MCS cognitive score at age 7	+ 0.54 s.d.
SDQ at age 5	SDQ at age 7	+ 0.71 s.d.
English picture vocab. test at age 5	Edinburgh reading test at age 10 Bristol friendly maths test at age 10	+ 0.13 s.d. + 0.09 s.d.
NCDS cognitive skills at age 7	Youth crime by age 16 Smoking at age 16 Depression at age 42	- 1.3% probability + 1.1% probability - 2.6% probability
	Employment at age 42 Hourly wage at age 42	+ 2.9% probability + 15.7%
BSAG social skills score at age 7	Truancy at age 16 Exclusion at age 16 Youth crime by age 16 Smoking at age 16 Adult crime during ages 33-42 Depression at age 42	- 2.2% probability - 0.2% probability - 1.6% probability - 1.3% probability - 1.2% probability - 1.9% probability
	Employment at age 42 Hourly wage at age 42	+ 2.1% probability + 2.5%
NFER-Nelson reading test at age 10	SEN in reading at age 10	- 11.2% probability
NFER-Nelson maths test at age 10	SEN in maths at age 10	- 2.6% probability

Notes: s.d. denotes standard deviation.

The estimates in table 5 are derived using robust analysis: the associations presented in the table are all statistically significant (at the 1 percent level with the single exception of the association between SDQ at age 3 and BAS at age 5 in Cullis & Hansen which is

statistically significant at the 10 percent level)⁷ and were estimated in multivariate regressions which included controls for other factors.

The strongest links between the child development measures are those between identical measures at different ages and over the relatively short period of two years. Interestingly, social skills at age seven appear to have a similar or greater association than cognitive skills with most of the outcomes at ages 16 or 42 (truancy, exclusion, crime, smoking⁸, depression and probability of employment), but cognitive skills have a much stronger association with the hourly wage in adulthood.⁹ The final row in the table shows a relatively strong association between reading and maths test scores and the probability of a child having Special Educational Needs (SEN) at age ten which may not be surprising as this is a link between outcomes at the same age.

It should be noted, however, that for most of the final outcomes, the associated differences are in terms of percentage probabilities. For example, the -1.3% probability of youth crime associated with a one standard deviation improvement in cognitive skills at age seven represents 1.3 out of every 100 sixteen year olds, while the difference in exclusion associated with social skills of -0.2% represents 2 in every 1,000 sixteen year olds. Given that a one standard deviation would normally be considered a large change in the initial measure (see section 2.3), these associations may be judged as relatively weak.

Figures 1 and 2 combine the links presented in table 5 to show the overall associations between the initial outcomes of BAS and SDQ at age three and the final outcomes for which monetary values can be estimated. In each figure, the blue boxes indicate initial outcomes at age three, the orange boxes indicate intermediate outcomes and the green boxes indicate final outcomes for which monetary values can be estimated.

In combining these links, it was necessary to assume that different measures of cognitive and social development at the same age have a one-to-one association in terms of standard deviations. That is, it has been assumed that a one standard deviation difference in BAS is associated with a one standard deviation in the MCS cognitive measure and a one standard deviation in the English picture vocabulary test at age five; and similarly for the MCS cognitive score and NCDS cognitive skills measure at age seven; the Edinburgh reading test and the NFER-Nelson reading test age ten; the Bristol Friendly maths test and the NFER- Nelson reading test at age ten; and the SDQ and the

⁷ Carneiro et al tested the associations between cognitive skills at age seven and truancy, exclusion and adult crime but these were not statistically significant and were not used in this report.

⁸ There is one counter-intuitive finding that higher cognitive skills at age seven are associated with a higher propensity to smoke at age 16, although it should be noted that this controls for a wide range of other factors which may influence smoking behaviour.

⁹ Although the development measures at age seven have different metrics, the use of a one standard deviation change means that the magnitudes of associations can be compared across the metrics.

BSAG social skills score at age seven. Full descriptions of these measures are provided in Annex A.

Figure 2: Links from BAS at age 3 to later outcomes



Figure 3: Links from SDQ at age 3 to later outcomes



The overall links presented in the figures indicate quite weak associations with most of the final outcomes. For example, the -0.18% probability of youth crime associated with a one standard deviation increase in BAS at age three represents around 2 out of every 1,000 sixteen year olds. The links between SDQ and SEN are some of the weakest, driven by the weak association between the social development measure at age three (SDQ) and the cognitive measure at age five (BAS). The strongest associations occur when the same measure is linked through several ages (such as SDQ through ages three, five and seven) and when the findings use links over longer periods (such as from age seven to adulthood in Carneiro et al). Most notably, both development outcomes at age three have relatively strong links to employment and wage outcomes at age 42.

3.2 The monetary value of later outcomes

Table 6 presents the monetary values of the final outcomes, noting whether the costs or benefits accrue to private individuals (the children experiencing early education), the Government (through increased revenues or reduced spending on services other than early education) or society more broadly (other individuals who did not use the early education).

The middle column presents the monetary values for the final outcomes derived from the cited sources with all figures updated to 2015 prices. There are some points to note about the sources and the values derived from them:

- The average annual cost per child for SEN is derived from total annual SEN spending from section 251 returns (table 2, DfE (2015b)) and the number of pupils with SEN on the school roll (table 1C, DfE (2015a)).
- The cost of truancy includes the cost of education and welfare services and the cost of exclusion from school includes Local Authority administrative costs and costs for alternative education and related social services, as reported in chapters 2 and 1 of Brookes et al (2007) respectively.¹⁰
- The costs of adult crime reported in New Economy (2015) also report an “economic cost” which may include lost earnings and is excluded here to avoid double-counting of the impact on earnings.
- The cost of smoking is derived from the total costs of smoking (ASH (2015)) divided by the number of smokers estimated from the proportion of the population

¹⁰ For both the costs of truancy and exclusion, Brookes et al also report lost earnings, health, crime and other related social services. However, these elements are not included because the lost earnings are captured more directly in other evidence, while the other costs are based on a dubious proxy of conduct disorder for both truancy and exclusion.

aged 16+ who smoke (figure 2.1 in HSCIC (2014)) and the size of the 16-90 population in England (ONS (2015a)).

- The cost of depression is the total amount spent on related services divided by the number of people with depression in McCrone et al (2008). The estimate of lost earnings due to depression is not included to avoid double counting.
- The value of expected earnings is estimated from employment rates (ONS (2015a)) and average gross earnings (ONS (2016a)) for different age groups and the division between net earnings and government revenue based on 2015 Income Tax and National Insurance parameters (HMRC (2016)).

The final column of table 6 presents the estimates of the lifetime value which can be applied to the changes in the final outcomes in figures 2 and 3. These include a number of assumptions:

- It is assumed that any reduction in the probability of SEN at age 10 reflects the same reduction across the ages 5 to 16 (and similarly for the probabilities of truancy across ages 11 to 16; exclusion across ages 13 to 16; smoking across ages 16 to 60; depression across ages 16 to 60 and employment across ages 16 to 60 and for the change in gross wage across ages 16 to 60).
- The lifetime value for the cost of exclusion includes the one-off LA administration cost for a new case at age 12 and the annual costs for alternative education and social services for ages 13 to 16.
- The youth crime measure is “any dealings with the court or police by age 16” and it is assumed that this equates to one young offender.
- The adult crime measure is “any dealings with the court or police between the ages of 33 and 42”. A conservative assumption is made that this equates to approximately one crime each 10 year period up to the age of 42 and the lifetime cost is modelled as the total of the costs of a crime at ages 22, 32 and 42.

It should be noted that the value of any impact on the probability of employment includes both changes in lifetime earnings and in welfare payments, while the value of any impact on the hourly wage is included in the impact on lifetime earnings.

Many of the costs of “problem” outcomes (all except earnings) are paid by the Government in the services needed to address these problems and require quite substantial amounts for each person per year or each incident. However, the highest value for the final outcomes is gross earnings both for the individual and the Government, driven both by high annual amounts and by the duration of the benefits over the lifetime.

Table 6: The monetary value of later outcomes

Later outcome	Reported monetary value per person per year (unless otherwise stated) in 2015 prices (sources)	Lifetime value (discounted to age three)
SEN	School + other services (govt cost) = £4,190 (DfE (2015a), DfE (2015b))	Ages 5–16: Govt = - £39,135
Truancy	Education + welfare services (govt cost) = £875 (Brookes et al (2007))	Ages 11–16: Govt = - £3,666
Exclusion	LA admin per new case (govt cost) = £1,123 Alternative education (govt cost) = £8,904 Social services (govt cost) = £1,417 (Brookes et al (2007))	Ages 13–16 (plus new case once at age 12) Govt = - £28,687
Youth crime	Justice process for each young offender (govt cost) = £8,725 (National Audit Office (2011))	Once at age 16: Govt = - £5,584
Adult crime	Justice process per crime (govt cost) = £703 Physical and emotional impacts on victims (society cost) = £1,903 (New Economy (2015))	Once each at ages 22, 32, 42: Govt = - £851 Society = - £2,303
Smoking	Health service + social care (govt cost) = £386 Taxation revenue (govt benefit) = £1,489 Private cost = £3,000 Lost productivity + fires (society cost) = £1,309 (ASH (2015), HSCIC (2014), ONS (2015a))	Ages 16 – 60: Govt = £17,957 Private = - £48,842 Society = - £21,311
Depression	Services (govt cost) = £1,585 (McCrone et al (2008))	Ages 16 – 60: Govt = - £25,804
Expected earnings	Mean annual gross pay x employment rate by age Income Tax + NI (govt benefit) = 31% Net earnings (private benefit) = 79% (ONS (2015b), ONS (2016a), HMRC (2016))	Ages 16 – 60: Govt = £90,295 Private = £230,107
Welfare payments	Welfare benefits for under 25 (govt cost) = £3,011 Welfare benefits for 25+ (govt cost) = £3,801 DWP (2015)	Ages 16 – 60: Govt = £57,869

Notes: See text for further explanation of the calculations. Private indicates benefits or costs accruing to private individuals (the children experiencing early education), Govt indicates those accruing to the Government (through increased revenues or reduced spending on services other than early education) and society indicates those accruing to society more broadly (other individuals who did not use the early education).

3.3 The value of improving early outcomes

The value of improving the child development outcomes at three can be calculated by combining the magnitudes of the associated changes in final outcomes presented in figures 2 and 3 with the value of these final outcomes presented in table 6. The values of changes in the same measures at age four can be calculated using two adjustments to the estimates for age three:

- In line with standard practice, all values of the final outcomes in table 6 need to be adjusted to allow for discounting back to age four rather than age three (by multiplying the values by 1.035). The values of the impacts are slightly higher from age four because the final outcomes are one year less into the future.
- The links to the first interim outcomes at age five should be adjusted for the associations from outcomes at age four. However, estimates of the links from age four are not available.¹¹ If the association between age three and four and that between age four and five were completely independent, the association between ages four and five could be estimated as the square root of the link over the two years. However, not only is independence likely to be an unrealistic assumption, it also generates much stronger associations from age four which have dramatic effects on the final valuations of the impacts.¹² Therefore, no adjustment is made and it is assumed that the associations between ages four and five are the same as those between ages three and five.

The estimated values of improving the measures of child development by one standard deviation at age three (and age four) are presented in table 7.¹³ The estimated value of a change in the BAS measures is around £8,500, with just over two thirds accruing to individuals and the remainder to the Government. Almost all of the value is derived from the effects on employment and hourly wages with much more minor contributions from reductions in Government spending on services for children with SEN and for adults with depression. The picture is broadly similar for SDQ: the estimated value of the change in the SDQ measure is estimated to be around £7,000, with almost two thirds accruing to individuals and most of the value being driven by employment outcomes. The main difference for the SDQ measure is that there are more gains for Government in reduced costs of services, although the reduction in smoking has a negative financial impact on Government revenue.

¹¹ Hawes and Dadds (2004) estimate that the average association in the SDQ over 12 month periods between the ages of four and nine is 0.77 but do not provide a direct estimate for age four to five.

¹² For example, the square root of the association in BAS between ages three and five (0.25) is 0.5. Using this as the association between ages four and five would double the estimated value of the initial impact.

¹³ Improving child development has two negative impacts (costs) around smoking. In the case of BAS, there are small negative private and society impacts because higher cognitive skills at age seven are associated with higher smoking. In the case of SDQ, there is a larger negative impact for the Government because the associated reduction in smoking reduces Government revenue from duties on cigarettes.

Table 7: Estimated value of improving child development at ages three and four

Value per child of associated difference in final outcomes (beneficiary)	Value of 1 standard deviation increase in BAS		Value of 1 standard deviation decrease in SDQ	
	Age 3	Age 4	Age 3	Age 4
Lower SEN (govt)	£165	£171	£13	£14
Lower truancy (govt)	no link	no link	£31	£33
Lower exclusion (govt)	no link	no link	£22	£23
Lower youth crime (govt)	£10	£10	£35	£36
Lower adult crime (govt)	no link	no link	£4	£4
Lower adult crime (society)	no link	no link	£11	£11
Lower smoking (govt)	£27	£28	- £91	- £94
Lower smoking (private)	- £72	- £75	£248	£257
Lower smoking (society)	- £32	- £33	£108	£112
Lower depression (govt)	£90	£94	£191	£198
Higher employment (govt)	£579	£600	£1,215	£1,259
Higher employment (private)	£899	£932	£1,887	£1,955
Higher wage (govt)	£1,910	£1,979	£882	£913
Higher wage (private)	£4,868	£5,043	£2,246	£2,327
Total govt	£2,781	£2,881	£2,303	£2,386
Total private	£5,695	£5,900	£4,381	£4,539
Total society	- £32	- £33	£119	£123
Grand total	£8,444	£8,748	£6,803	£7,048

Part of the reason for the high value of increases in earnings relative to reductions in the costs of services for Government is that there are stronger links between the initial outcomes and the employment and wage outcomes than for the later “problem” issues. However, the main driver of the difference is that a small proportional impact on earnings will have an effect on a relatively high annual amount for a large number of years for most individuals. In comparison, even large effects on the prevalence of the “problem”

outcomes will affect a much smaller number of individuals over fewer years and have lower annual amounts of money involved.

It is interesting to note how similar the valuations are from the two measures when one captures cognitive development and the other social development. However, it may not be surprising that improved cognitive development has a greater impact on lifetime earnings through a higher hourly wage, while improved social development generally has a greater impact in reducing individual and social “problem” outcomes.

Finally, it should be noted again that a one standard deviation change in any measure can be classified as a “large” to “very large” change.¹⁴ A “medium” change would be 0.5 of a standard deviation and the valuations associated with this size of change in the child development measures at ages three and four are around £4,000.

3.4 Summary

This chapter has described the estimation of the monetary value of improving child development at ages three and four using evidence from the existing literature. It has identified a number of ways in which initial outcomes can be linked to later outcomes which have monetary value for private individuals, the Government and society more broadly.

The monetary values of similar sized improvements in the BAS measure of cognitive development and the SDQ measure of social development are quite close: a change in these outcomes at age three or age four of around half a standard deviation would have a monetary return of around £4,000. Such changes correspond to around 8.5 points on the BAS scale (which ranges from 10 to 141) or around 2.5 points on the SDQ scale (which ranges from 0 to 40)¹⁵.

Most of the value of improvements in early child development is due to links with later earnings and most of the value accrues to individuals rather than the Government or society more broadly. The reason for the high value of the earnings return relative to reductions in the costs of services for Government is partly because there are stronger links to employment outcomes than to other later outcomes, but mostly because a small proportional impact on earnings will have an effect on a relatively high annual amount for a large number of years for most individuals. In comparison, even large effects on the prevalence of the “problem” outcomes will affect a much smaller number of individuals over fewer years and have lower annual amounts of money involved.

¹⁴ Sawilowsky (2009) suggests that changes of 0.01, 0.2, 0.5, 0.8, 1.2 and 2.0 of a standard deviation might be classified as “very small”, “small”, “medium”, “large”, “very large” and “huge” respectively.

¹⁵ Standard deviations are from table 2.4 in Washbrook (2010).

4. The value of improving Key Stage 1 attainment at age seven

This chapter presents new analysis of the National Pupil Database (NPD) to estimate the relationships between Key Stage 1 (KS1) attainment at age seven and later life outcomes. As this chapter contains previously unpublished analysis, the data sample and measures are described in some detail in the first section. The findings on the associations between KS1 outcomes and the later outcomes of Special Educational Needs (SEN), truancy, exclusion and lifetime earnings are presented in the following section, while the third section considers the evidence on the monetary value of these later outcomes. The penultimate section presents estimates of the monetary value of improvements in KS1 outcomes and the final section summarises the findings.

4.1 The NPD sample

Data is analysed from three cohorts of pupils in the NPD who completed Key Stage 1 (KS1) at age seven in 2002 to 2004 and whose final school year (Year 13) was in 2013 to 2015. These cohorts were the most recently available and three cohorts were used to ensure a sufficiently large sample size.

Pupils are assessed at the end of KS1 in five subjects: speaking and listening, reading, writing, mathematics and science. In each subject, pupils are allocated an attainment level between 0 and 4, where level 2 is the expected level of attainment. Reading, writing and mathematics are considered the 'main' subjects and form the basis of school performance tables (DfE (2016)). A total point score can be calculated for the three main subjects and for all five subjects by summing the level achieved across the subjects. Four alternative measures of KS1 attainment were considered in this analysis:

- whether a pupil achieved the expected level in all subjects
- whether a pupil achieved the expected level in all main subjects
- the total point score across all subjects
- the total point score across all main subjects

Summary statistics by cohort are presented in table 8. Attainment has been relatively stable throughout the years. Around 80 percent of pupils achieved the expected level in the three main subjects and 78 percent achieved the expected level in all subjects. Pupils achieved an average 6.19 points across all main subjects (out of a maximum of 12 points) and 10.42 points across all subjects (out of a maximum of 20 points). The four KS1 attainment measures are highly correlated with one another: pairwise correlation coefficients range between 0.72 and 0.94 and are all statistically significant at the 1 percent level.

Table 8: Summary statistics for KS1 attainment in the NPD

Mean (standard deviation)	2002 cohort	2003 cohort	2004 cohort	All cohorts
Achieved Level 2 in main KS1 subjects	80% (0.399)	80% (0.403)	80% (0.401)	80% (0.401)
Achieved Level 2 in all KS1 subjects	78% (0.416)	77% (0.418)	78% (0.416)	78% (0.417)
Total points in main KS1 subjects	6.18 (1.828)	6.18 (1.888)	6.20 (1.886)	6.19 (1.887)
Total points in all KS1 subjects	10.42 (2.901)	10.41 (2.972)	10.44 (2.970)	10.42 (2.948)
Number of observations	585,953	576,820	586,584	1,749,357

Source: NPD analysis, 2001/02-2003/04 KS1 cohorts

The associations between KS1 attainment and later life outcomes were estimated using all four measures and yielded qualitatively similar results. The preferred measure is the total point score across all subjects because this allows substantial variation between pupils and also has the highest predictive power in terms of the level of qualification achieved (and thereby earnings). Estimated impacts using the other three measures are reported in Annex C and may be used in the final value for money analysis in SEED if the impact analysis indicates that these alternative KS1 measures have stronger associations with the use of early education.

Table 9 presents the sample statistics for the later outcomes of SEN, truancy, school exclusions and educational attainment:

- Nearly half of all pupils received SEN support at some point during their schooling after KS1, including children with SEN statements and those on School Action or School Action Plus. The average number of years of SEN support was 2.6 across all pupils and 5.4 across pupils who received SEN support at some point.
- On average, 5.7 percent of pupils are classified as persistently truant at some point after KS1, where persistent truancy is defined as missing five weeks or more in an academic year through unauthorised absences. The average number of years of truancy was 0.1 across all pupils and 1.7 across pupils who are persistently truant at some point. It should be noted that the data on truancy is only available for the 2004 cohort.
- Around seven percent of pupils are permanently excluded at some point in their schooling, which means that they no longer allowed to attend their current school and most move to a Pupil Referral Unit (PRU).

- Across the three cohorts, 23 percent of pupils achieved fewer than 5 GCSEs at grades A*-C, 31 percent achieved 5 GCSEs at grades A*-C but no A Levels, and 46 percent achieved at least one pass at A Levels. These highest educational attainment groups were selected to match those in the evidence source used to value the benefits of higher educational attainment (Cattan et al (2014)).

Table 9: Summary statistics for later outcomes in the NPD

Outcome	Statistic	Number of observations
Receipt of SEN support after KS1: - percentage of pupils - mean (s.d.) number of years for all pupils - mean (s.d.) number of years for ever SEN pupils	48% 2.58 (3.34) 5.38 (2.87)	1,756,116
Persistent truancy after KS1: - percentage of pupils - mean (s.d.) number of years for all pupils - mean (s.d.) number of years for ever truant pupils	5.7% 0.10 (0.46) 1.68 (1.04)	588,702
Permanently excluded after KS1: - percentage of pupils	7.1%	1,756,116
Percentage with highest level of educational attainment: - fewer than 5 GCSEs at A*-C - 5 GCSEs at A*-C - at least 1 A Level	23% 31% 46%	1,381,938

Source: NPD analysis, 2001/02-2003/04 cohorts

Notes: Data on persistent truancy is only available for the 2004 cohort as data on absences has only been collected since 2006.

4.2 Associations between KS1 attainment and later outcomes

Table 10 presents the estimated associations between the KS1 total points score across all subjects and later outcomes. The full regression results are presented in Annex B, while results for regressions with variations in the specification of KS1 attainment and the highest educational qualification are presented in Annex C.

The table presents results for the simple correlation between KS1 attainment and later life outcomes (model 1 without any additional variables) and the relationship controlling for pupils' background characteristics including gender, ethnicity, SEN status prior to KS1 assessments and socioeconomic status (model 2 with controls). The results from model 2 are used in the monetary valuations below as they remove the element of the

associations which may be due to other related factors. For interest, the differences in the associations with KS1 attainment are also reported separately for boys and girls (model 3 which includes an interaction term for KS1 attainment and gender) and for pupils who have ever been eligible for free school meals (FSM) and those who have not (model 4 which includes an interaction term for KS1 attainment and ever FSM). The models for number of years of SEN and number of years of truancy are estimated using linear regression models (as they are continuous variables), while those for the proportion of pupils with a permanent exclusion use a logit probability model (for the binary outcome) and those for the proportions in the three categories of highest qualification use multinomial logit models (appropriate for three or more outcomes).

Table 10: Associations between KS1 attainment and later outcomes

Marginal effects for total points in all KS1 subjects	Model (1) KS1 only	Model (2) with controls	Model (3) with female interaction: - boys - girls	Model (4) with FSM interaction: - not FSM - FSM
Number of years of SEN	- 0.060 ***	- 0.421 ***	- 0.452 *** - 0.385 ***	- 0.400 *** - 0.458 ***
Number of years with persistent truancy	- 0.022 ***	- 0.009 ***	- 0.008 *** - 0.010 ***	- 0.003 *** - 0.019 ***
Proportion of pupils with a permanent exclusion	- 0.009 ***	- 0.003 ***	- 0.003 *** - 0.005 ***	- 0.006 *** - 0.002 ***
Highest qualification*: - fewer than 5 GCSEs at A*-C	- 0.065 ***	- 0.050 ***	- 0.049 *** - 0.050 ***	- 0.055 *** - 0.042 ***
- at least 1 A Level	0.085 ***	0.072 ***	0.072 *** 0.072 ***	0.077 *** 0.057 ***

Source: NPD analysis, 2001/02-2003/04 cohorts

Notes: * The omitted highest qualification category is the middle category of 5 GCSEs at A*-C. All marginal effects are statistically significantly different from zero at the 1 percent level (indicated by ***).

This analysis shows that a one-point increase in KS1 reduces the expected duration of SEN support after KS1 by 0.42 years, controlling for background characteristics. The effect is slightly smaller for girls than for boys, with a difference 0.07 years. The effect size is 0.06 years larger for pupils who have ever been eligible for free school meals than for pupils who have never been eligible.

A one-point increase in the total point score across all KS1 subjects reduces the expected length of persistent truancy by 0.009 years, controlling for background

characteristics. The effect is slightly greater for girls than boys, who, on average, experience 0.002 fewer years of persistent truancy for every one-point increase in KS1 than for boys. The effect is substantially larger for pupils who have been eligible for free school meals at some point in their schooling (0.019 years), than for pupils who have never been eligible for free school meals (0.003 years).

A one-point increase in KS1 is associated with a 0.3 percentage point reduction in the probability of ever being permanently excluded from school after KS1, controlling for background characteristics. The impact of KS1 attainment on the probability of exclusion is more pronounced for girls than boys: on average, each additional point reduces the probability of exclusion by 0.5 percentage points for girls and by 0.3 percentage points for boys. The impact is smaller for pupils who have ever been eligible for free school meals (0.2 percentage points), compared to pupils who have never been eligible (0.6 percentage points).

Finally, the analysis shows that controlling for background characteristics, a one-point increase in the total point score across all KS1 subjects reduces the probability of achieving fewer than 5 good GCSEs (at grades A*-C) by 5 percentage points, and increases the probability of achieving at least 1 A Level by 7 percentage points. The effect size is not markedly different for girls and for boys, but is smaller for pupils who have ever been eligible for free school meals. A one-point increase in KS1 attainment leads to a 1 percentage point smaller reduction in the probability of achieving fewer than 5 good GCSEs compared to pupils who have never been eligible for FSM and a 2 percentage points smaller increase in the probability of achieving at least 1 A Level.

Results for an alternative specification using 5 GCSEs at grades A*-C including English and Mathematics (instead of 5 GCSEs at grades A*-C in any subjects) indicate that KS1 attainment has a slightly larger effect in reducing the probability of not achieving 5 GCSEs (a one-point increase in the KS1 score reduces the probability by 8.5 percentage points), but there is little difference in the impact on the probability of achieving at least one A level. Full results for this alternative specification are presented in Annex C.

4.3 The monetary value of later outcomes

The estimated monetary value of reductions in the prevalence of SEN and truancy with higher KS1 attainment are calculated using the valuations presented in section 3.3 above. A slightly different estimate is used for the cost of exclusions because the measure in this chapter is the probability of ever being excluded rather than the annual probability of exclusion and a new source is used to estimate the value of higher educational attainment.

Brookes et al (2007) estimate that the cost of permanent exclusion in 2006 and discounted to age six was £22,263 to the education system (£748 in administration costs plus £21,515 in alternative education provision) and £3,504 for greater use of social

services up to age 16. Taken together, this represents a total cost of £27,828 in 2015 prices and discounted to age three.

There are several sources of evidence linking educational attainment to lifetime earnings. Our preferred source is Cattan et al (2014) which provides some of the most up-to-date estimates of the returns to qualifications. Hayward et al (2014) and Walker and Zhu (2013) provide viable alternative estimates, but use of the estimates from these studies would require a large number of assumptions to adjust their estimated returns to match the analysis in this report. A detailed comparison of the estimates in Cattan et al (2014) and the alternative papers can be found in Annex B in Gaheer and Paull (2016).

Cattan et al (2014) use data from the British Household Panel Survey (BHPS) and the Labour Force Survey (LFS) to model the impact of educational attainment on expected lifetime earnings, taking into account both the impact on earnings and movements in and out of employment. Table 11 presents their simulated lifetime earnings for men and women at each qualification level in 2013 prices and discounted to age four and a weighted average based on the percentages of boys and girls aged three in 2014 (ONS 2016b).

Table 11: Average simulated gross lifetime earnings by qualification level

Average lifetime earnings in 2013 prices discounted to age 4	Males	Females	All
Fewer than 5 GCSEs at A*-C	£364,435	£163,915	£266,594
5 GCSEs at A*-C	£477,563	£243,238	£363,228
At least 1 A Level	£670,120	£388,723	£532,817

Source: Cattan et al. (2014), adjusted using ONS (2014, 2016b)

Notes: The estimates for the “At least 1 A level” group is the average gross lifetime earnings for A Levels and university degrees presented in Cattan et al weighted by the current distribution of individuals with level 3 and level 4 highest qualifications in the population aged 16 and over from ONS (2014).

Indexing to 2015 and discounting to age three, these estimates suggest that the average lifetime value of earnings is £95,610 greater for pupils who achieve 5 GCSEs at grades A*-C (but no A levels) than those who achieve less, whilst pupils who achieve at least 1 pass at A Level can expect to earn £167,791 more than those with five good GCSEs. Using the calculations applied to gross earnings in section 3.2, 79 percent of these gross earnings accrue to the individual in net earnings, while 31 percent accrues to the Government in income tax and employee and employer National Insurance contributions. Another potential saving to the Government from higher educational attainment is reduced welfare payments due to a higher likelihood of being in work. However, Cattan et al do not explicitly model the impact on time spent in employment and the value of reduced welfare payments cannot be estimated without the information relating highest qualification to the likelihood of unemployment.

4.4 The value of improving KS1 attainment

An estimate of the value of improvements in KS1 attainment can be obtained by combining the value of each later outcome with the estimated impact on that outcome. Table 12 presents these three elements for early education at age two for a 3 point increase in KS1 attainment which is approximately equal to a one standard deviation change. This is a similar magnitude to the changes considered for outcomes at ages three and four in the previous chapter.

Table 12: Estimated value of improving KS1 attainment

Reported monetary value of outcomes in 2015 prices (beneficiary)	3 point increase in KS1 attainment	
	Associated difference in final outcome	Value per child discounted to age 3
SEN: annual cost (school + other services) (govt) = £4,190	- 1.263 years	£3,916
Truancy: annual cost (education + welfare services) (govt) = £875	- 0.027 years	£17
Exclusion: cost per case discounted to age 3 (LA admin, alternative education + social services) (govt) = £27,828	- 0.009 cases	£250
Lifetime earnings: 5 good GCSEs discounted to age 3: - Net earnings (private) = £75,532 - Income tax and NI revenue (govt) = £29,639	0.150 higher proportion	£11,330 £4,446
Lifetime earnings: at least one A level discounted to age 3: - Net earnings (private) = £132,555 - Income tax and NI revenue (govt) = £52,015	0.216 higher proportion	£28,632 £11,235
Total govt		£19,864
Total private		£39,962
Grand total		£59,826

Note: The value of years of SEN and years of truancy are discounted to age three using the average discount rate between ages 8 and 16.

For early education at age three, the estimated values are discounted to age four rather than age three by multiplying the figures in table 12 by 1.035, generating a total value of £61,920, with £20,559 accruing to the Government and £41,361 accruing to individuals.

Overall, a 3 point increase in the total point score across all KS1 subjects generates a value of around £60,000 for either year of early education. Around two thirds of this value accrues to individuals through higher lifetime net earnings, with the remainder accruing to

the Government through higher Income Tax and National Insurance revenues and reduced spending, mainly on SEN services. The vast majority (93 percent) of the total value stems from the impact of KS1 attainment on lifetime earnings.

4.5 Summary

This chapter has presented an analysis of the relationships between KS1 attainment at age seven and SEN, truancy, school exclusion and the highest qualification level achieved. An improvement of around half a standard deviation in the total points score for all KS1 subjects is estimated to have a monetary value of around £30,000. As with the child development measures at ages three and four, most of the value of improvements in KS1 attainment is due to links with later earnings and most of the value accrues to individuals rather than the Government or society more broadly. The reasons are also similar: the high value of the earnings return is due in part to stronger links with lifetime earnings and because a small proportional impact on earnings will have an effect on a relatively high annual amount for a large number of years for most individuals.

This value of improvements in KS1 attainment is considerably higher than the estimated value (around £4,000) for similar sized changes in child development at ages three and four. The reason for this is the stronger association between the outcome at age seven and later outcomes which is driven by several factors:

- Age seven is marginally closer in time to the final outcomes of value.
- The outcome (KS1 attainment) at age seven is much more closely related in its nature to the key driver of earnings (highest qualifications).
- A single data source which tracks individuals from age seven to educational attainment can be used to estimate the links.

Against this potential higher value, there is a need to balance the possibility that any impacts of early education may have faded by age seven. On the other hand, the effects could grow larger over time if immediate impacts on other factors such as child health and the home learning environment have later effects on educational achievement.

Finally, it is worth noting that the impacts of KS1 attainment and background characteristics (including gender, ethnicity, SEN status and socioeconomic status) on later outcomes are not currently analysed on a regular basis using the NPD data, but this could be undertaken on a routine basis using the models developed here.

5. Cost benefit breakeven analysis

This chapter combines the estimates of the values of improving outcomes from chapters three and four with costs of delivery from an earlier SEED report to estimate the breakeven points for impacts at ages three, four and seven. The first section presents the cost estimates from the previous report, while the second section presents the breakeven impacts for the different outcomes. The third section explores how the estimated breakeven points vary across different types of provision, while the final section summarises the findings.

5.1 Costs of delivering early education

A previous SEED report (Blainey & Paull (2017)) presented estimates of the hourly cost of delivering childcare and early education for different ages of children. It drew on data on delivery costs and funding collected from 166 settings in 2015 from all regions in England. The sample was selected from a pool of 675 settings that had taken part in an earlier stage of quality assessments in SEED, which itself had been drawn from settings used by parents in the SEED longitudinal survey of families and children. The sample was selected to broadly match the quality visit sample in a number of characteristics and was weighted in the analysis to match the distribution of places across different types of providers in the Childcare and Early Years Providers' Survey.

The cost and funding data was collected using semi-structured face-to-face interviews (usually with setting managers) in order to ensure that complete and accurate information was obtained. Data was collected on the number and age of children in each session; time use and salaries for all staff; the time use of different rooms and venue costs; all other non-staff and non-venue costs; and the revenue sources for four age groups of children. All information was collected for a typical week in the month preceding the visit or for the most recent appropriate financial period. Further details on the derivation of the hourly cost for each age of child can be found in the original report.

Table 13 presents the hourly costs from this earlier report for two year olds and for three year olds. The hourly costs are also presented for three types of provider: PVI (private, voluntary and independent), maintained (nursery classes in schools, nursery schools, Local Authority nurseries and Children's Centres) and childminders. The costs are also presented by three quality levels. Quality was directly measured for each setting as part of SEED and the measure used here is a mixture of ITERS, ECERS and SSTEW. The three levels (lowest, middle and highest) simply divide the sample into three roughly equal groups. Further details and precise definitions for the provider type and quality measures are presented in Annex D. Table 13 also presents the annual cost per child. This is simply the hourly cost multiplied by 570 annual hours for part-time (15 weekly hours for 38 weeks) and by 1560 annual hours for full-time (30 weekly hours for 52 weeks).

Table 13: Costs of delivering early education

	Two year olds		Three year olds	
	Hourly cost per child	Annual cost per child	Hourly cost per child	Annual cost per child
By part-time and full-time				
Part-time (15 hours per week for 38 weeks)	£4.30	£2,451	£3.72	£2,120
Full-time (30 hours per week for 52 weeks)	£4.30	£6,708	£3.72	£5,803
Part-time by provider type				
PVIs	£3.87	£2,206	£3.23	£1,841
Maintained	£5.73	£3,266	£4.51	£2,571
Childminders	£5.35	£3,050	£4.77	£2,719
Part-time by quality				
Lowest	£4.06	£2,314	£3.58	£2,041
Middle	£4.16	£2,371	£3.58	£2,041
Highest	£4.67	£2,662	£4.00	£2,280

Note: Hourly rates are from tables 1, 2, 3 and 24 in Blainey & Paull (2017) except for those for “maintained” which are calculated from the raw cost data. PVIs are private, voluntary and independent settings. Descriptions of the provider types and the quality measure is provided in Annex D.

5.2 Breakeven impacts for early education

Later analysis from SEED will provide estimates of the impacts on the outcomes at ages three, four and seven. When these estimates are available, they can be combined with the cost information presented in the previous section to derive two types of measures of value for money:

- **Total value for money** which compares the total value of the benefits of the impacts to the delivery cost.
- **Value for money for Government** which compares the value of the benefits which accrue to the Government to the delivery cost.

In both cases, value for money is captured in the “benefit to cost ratio” which is simply the value of the benefits divided by the cost. If this ratio is greater than one, the estimated value of the benefits exceeds the cost and early education can be said to offer positive

value for money. The value for money of early education at age two will be estimated for the two outcomes (BAS and SDQ) at age three and for the single outcome (KS1 score) at age seven, reflecting both the immediate and longer term value for money. Similarly, the value for money for early education at age three will be estimated for the two outcomes (BAS and SDQ) at age four and for the single outcome (KS1 score) at age seven.

Prior to the estimation of actual impacts, it is useful to consider the level of impacts required to achieve positive value for money (defined as “breakeven impacts”) using the cost data presented in the previous section and the estimates of the values of the impacts derived in the previous chapters. These “breakeven impacts” are defined as the level of impact required for the estimated value of the benefits to exactly equal the delivery cost. If the actual impact exceeds this breakeven point, there is positive value for money. Estimation of these breakeven impacts provides early insight into whether positive value for money is feasible (that is, whether the breakeven impact lies within the range of the outcome metric) and into the variation in the size of the breakeven impacts across the different outcomes and types of provision.

In order to help explain how the breakeven impacts are calculated, table 14 presents example calculations of the benefit to cost ratios. An example impact of 0.25 of a standard deviation is considered, but it should be noted that this bears no relation to the potential size of actual impacts and has been selected simply as a useful level to illustrate the calculations.

Table 14: Example benefit to cost ratio calculations

Example impacts of 0.25 of a standard deviation	Total value for money		Value for money for Government	
	Value of benefit	Benefit to cost ratio	Value of benefit	Benefit to cost ratio
Part-time early education at age two (cost = £2,451)				
Increase in BAS at age three	£2,111	0.86	£695	0.28
Reduction in SDQ at age three	£1,701	0.69	£576	0.23
Increase in KS1 score at age 7	£14,957	6.10	£4,966	2.03
Part-time early education at age three (cost = £2,120)				
Increase in BAS at age four	£2,187	1.03	£720	0.34
Reduction in SDQ at age four	£1,762	0.83	£597	0.28
Increase in KS1 score at age 7	£15,480	7.30	£5,140	2.42

The first column in table 14 presents the estimate values of an impact of 0.25 of a standard deviation for each of the three outcomes (BAS, SDQ and KS1 score) for part-time early education for two years old and for three years olds. For example, a 0.25 standard deviation increase in the BAS measure at age three has an estimated value of £2,111. The second column presents the benefit to cost ratio which is calculated by dividing the value by the cost. For example, dividing the benefit of £2,111 for BAS at age three by the annual cost of early education for a two year old (£2,451) generates a benefit-cost ratio of 0.86. Similarly, the third column presents the estimated value of a 0.25 increase in the BAS score at age three which accrues to the Government (£695) and dividing this by the cost (£2,451) generates a Government benefit to cost ratio of 0.28.

Unsurprisingly given the much higher value associated with changes in the KS1 score at age seven, the benefit to cost ratios for early education for both age groups are higher for the KS1 score at age seven (a ratio of around 6 to 7) than for the BAS and SDQ impacts at ages three and four (a ratio of around 1 or less). The ratios are slightly higher for early education at age three than at age two because of the slightly lower cost for the older age group and because the value of future benefits are discounted one year less for the older age group. As around one third of the value of the impacts accrue to the Government for all the outcomes, the benefit to cost ratios for the Government value for money are around one third those of the ratios for the total value for money.

Table 15 presents the breakeven impacts for the total value for money. These breakeven impacts are presented both in terms of standard deviations (allowing comparisons across the different outcomes) and in terms of the outcome metric (allowing an assessment of the feasibility of the impact). The breakeven impact in standard deviations is calculated by dividing the cost by the value of a one standard deviation change to obtain the size of impact required for the benefit to exactly equal the cost. For example, dividing the cost for early education at age two (£2,451) by the value of a one standard deviation increase in BAS at age three (£8,444) generates a breakeven impact of 0.29. This breakeven impact in standard deviations is then multiplied by the standard deviation for each outcome to obtain the breakeven impact in the outcome metric. For example, the 0.29 standard deviation breakeven impact for the BAS score at age three is multiplied by the standard deviation of 17.19 to obtain the breakeven impact of an increase of 4.95 in the BAS score (noting that there is some rounding in the presented numbers).

The lower cost of early education at age three and slightly higher value of impacts at age four mean that the breakeven impacts levels are slightly lower for early education at age three than at age two for all three measures. For the child development outcomes at ages three and four, the breakeven impacts lie in the range of what might be classified as “small” to “medium”, while those for the KS1 scores lie in the range of “very small” to

“small”.¹⁶ This reflects that comparable sizes of change across the outcomes (i.e. a one standard deviation change) have greater value for the age seven measure than for the measures at ages three and four. However, it should be noted that impacts at age seven may be smaller than at the earlier ages if the effects fade over time. On the other hand, the effects could grow larger over time if immediate impacts on other factors such as child health and the home learning environment have later effects on educational achievement.

Table 15: Breakeven impacts for total value for money

	Delivery cost per child	Value of an impact of 1 standard deviation	Breakeven impacts where benefit = cost	
			In standard deviations	In outcome metric
Part-time early education at age two				
Increase in BAS at age three	£2,451	£8,444	0.29	4.99
Reduction in SDQ at age three	£2,451	£6,803	0.36	1.78
Increase in KS1 score at age 7	£2,451	£59,826	0.04	0.12
Part-time early education at age three				
Increase in BAS at age four	£2,120	£8,748	0.24	4.17
Reduction in SDQ at age four	£2,120	£7,048	0.30	1.49
Increase in KS1 score at age 7	£2,120	£61,920	0.03	0.10

Notes: The BAS measure has a range of 10 to 141 with an estimated mean value of 74.35 and standard deviation of 17.19 and the SDQ measure has a range of 0 to 40 with an estimated mean value of 8.9 and standard deviation of 4.94 (Washbrook (2010), table 2.4)). The KS1 score has a range of 0 to 20 with an estimated mean value of 10.42 and standard deviation of 2.948 (table 8 above).

The BAS measure ranges from 10 to 141 and has an estimated mean value of 74 (Washbrook (2010)) which means that the breakeven impact of an increase of between 4 and 5 is well within the feasible range. The SDQ measure ranges from 0 to 40 and has an estimated mean value of 9 (Washbrook (2010)), which, again, means that the estimated breakeven impact of a reduction of between 1.5 and 2 is within the feasible range. Similarly, an increase of around 0.1 for the KS1 score at age seven lies within the

¹⁶ Sawilowsky (2009) suggests that changes of 0.01, 0.2, 0.5, 0.8, 1.2 and 2.0 of a standard deviation might be classified as “very small”, “small”, “medium”, “large”, “very large” and “huge” respectively.

feasible range, given that the range for this score is 0 to 20 and the mean value is 10 (table 8 above).

Table 16 presents the breakeven impacts for the value for money for Government. Again, these breakeven impacts are presented both in terms of standard deviations and in terms of the outcome metric and are calculated in an analogous manner to those in table 15. The key difference is that the value of the impacts are lower, capturing only those benefits which accrue to the Government and the breakeven impacts are consequently higher.

Table 16: Breakeven impacts for Government value for money

	Delivery cost per child	Value of an impact of 1 standard deviation	Breakeven impacts where benefit = cost	
			In standard deviations	In outcome metric
Part-time early education at age two				
Increase in BAS at age three	£2,451	£2,781	0.89	15.15
Reduction in SDQ at age three	£2,451	£2,303	1.06	5.26
Increase in KS1 score at age 7	£2,451	£19,864	0.12	0.36
Part-time early education at age three				
Increase in BAS at age four	£2,120	£2,881	0.74	12.65
Reduction in SDQ at age four	£2,120	£2,386	0.89	4.39
Increase in KS1 score at age 7	£2,120	£20,559	0.10	0.30

Notes: See previous table notes.

As around one third of the values of the benefits of the impacts accrue to the Government for all the outcomes, the breakeven impacts for the value for money for the Government are all around three times larger than those for the total value for money. For the child development outcomes at ages three and four, the breakeven levels of impact lie in the range of what can be classified as “large” to “very large”, while those for the KS1 scores continue to lie in the range of “very small” to “small”, although all the breakeven impacts are within the range of the metric for each outcome.

5.3 Variation in breakeven impacts across types of provision

The value for money may vary across different types of provision because there are variations in costs or because there are variations in the sizes of impacts. This can mean that higher cost types of provision may offer better or worse value for money depending

upon whether they offer sufficiently higher impacts for their value to outweigh the additional costs. This will be explored in later analysis from SEED when the size of impacts across different types of provision has been estimated.

Prior to the estimation of actual impacts, it is useful to consider how the variation in cost across different types of provision drives differences in breakeven impacts for the total value for money. Implicitly, this explores how the cost side alone affects the value for money across different types of provision, both in absolute terms for each provision type and in relative terms across different types of provision. In particular, the variation in the breakeven impacts indicates the required size of additional impact for higher cost provision to offer better value for money than lower cost options.

Table 17: Variation in breakeven impacts across types of provision: two year olds

	Delivery cost per child	Breakeven impacts					
		BAS at age three		SDQ at age three		KS1 score at age seven	
		s.d.	BAS metric	s.d.	SDQ metric	s.d.	KS1 metric
By part-time and full-time							
Part-time	£2,451	0.29	4.99	0.36	1.78	0.04	0.12
Full-time	£6,708	0.79	13.66	0.99	4.87	0.11	0.33
Part-time by provider type							
PVIs	£2,206	0.26	4.49	0.32	1.60	0.04	0.11
Maintained	£3,266	0.39	6.65	0.48	2.37	0.05	0.16
Childminders	£3,050	0.36	6.21	0.45	2.21	0.05	0.15
Part-time by quality							
Lowest	£2,314	0.27	4.71	0.34	1.68	0.04	0.11
Middle	£2,371	0.28	4.83	0.35	1.72	0.04	0.12
Highest	£2,662	0.32	5.42	0.39	1.93	0.04	0.13

Tables 17 and 18 present the breakeven impacts across the different types of provision for two year olds and three years olds respectively. The initial column in both tables reproduces the annual costs of provision from table 13, showing the variation in cost by dosage (part-time and full-time), type of provider and quality of delivery. The subsequent columns present the breakeven impacts, calculated in the same way as for table 15 using the values of the impacts of a one standard deviation change reported in table 15. The

figures in the first row in each table reproduce the breakeven impacts for the base case (15 hours) of part-time early education for all types and quality of provision shown in table 15.

Table 18: Variation in breakeven impacts across types of provision: three year olds

	Delivery cost per child	Breakeven impacts					
		BAS at age four		SDQ at age four		KS1 score at age seven	
		s.d.	BAS metric	s.d.	SDQ metric	s.d.	KS1 metric
By part-time and full-time							
Part-time	£2,120	0.24	4.17	0.30	1.49	0.03	0.10
Full-time	£5,803	0.66	11.40	0.82	4.07	0.09	0.28
Part-time by provider type							
PVIs	£1,841	0.21	3.62	0.26	1.29	0.03	0.09
Maintained	£2,571	0.29	5.05	0.36	1.80	0.04	0.12
Childminders	£2,719	0.31	5.34	0.39	1.91	0.04	0.13
Part-time by quality							
Lowest	£2,041	0.23	4.01	0.29	1.43	0.03	0.10
Middle	£2,041	0.23	4.01	0.29	1.43	0.03	0.10
Highest	£2,280	0.26	4.48	0.32	1.60	0.04	0.11

As the breakeven points vary only by the differences in cost, they are proportional to the variation in cost across the different types of provision. The annual cost for full-time early education is, by definition, 2.7 times that for part-time for both age groups (1560 hours each year for full-time compared to 570 hours for part-time) and the breakeven impacts for full-time are 2.7 times greater than for part-time for both age groups. The cost differences across provider type and quality of provision reflect only the differences in the hourly cost shown in table 13 and are much smaller. The cost for maintained providers is only 1.5 times (1.4 times) that for PVI providers for two year olds (three year olds) and the cost for the highest quality providers is only 1.2 times (1.1 times) that for the lowest quality providers for two year olds (three year olds) with corresponding differences in the breakeven impacts.

In absolute terms, the breakeven impacts for full-time early education for the BAS and SDQ measures lie in the range of what may be classified as “large” to “very large” for two

year olds and in the range of “medium” to “large” for three year olds. The breakeven impacts across different types of provider and different quality levels remain within the same range as the breakeven impact for all types, that is, between “small” and “medium” for the BAS and SDQ measures at ages three and four and between “very small” and “small” for the KS1 measure at age seven. In addition, the breakeven impacts are within the range of the metric for all outcomes.

Overall, the breakeven impacts highlight that it will take considerably larger impacts for full-time early education to offer better value for money over part-time early education, but relatively small differences in impacts across different types of providers or quality of providers could mean that higher cost options offer better value for money.

5.4 Summary

Prior to the estimation of actual impacts in later stages of SEED, this chapter has estimated breakeven impacts (the levels required for the estimated value of the benefits to exactly equal the delivery cost) using cost data from a previous SEED report and the estimated value of improving child outcomes from the earlier chapters. This provides early insight into whether positive value of money is feasible and into the variation in the size of the breakeven impacts across different outcomes and types of provision.

For total value for money (a comparison of the value of all benefits to the delivery cost), the breakeven impacts for the child development outcomes at ages three and four lie in the range of what might be classified as “small” to “medium”, while those for the KS1 scores at age seven lie in the range of “very small” to “small”. However, it should be noted that impacts at age seven may be smaller than at the earlier ages if the effects fade over time. On the other hand, the effects could grow larger over time if immediate impacts on other factors such as child health and the home learning environment have later effects on educational achievement. In all cases, the breakeven impacts are within the range of the metric for each outcome.

For the value for money for Government (a comparison of the value of the benefits which accrue to the Government to the delivery cost), the breakeven impacts are around three times larger, reflecting the fact that about one third of the value of the benefits accrue to the Government. For the child development outcomes at ages three and four, the breakeven levels of impact lie in the range of “large” to “very large”, while those for the KS1 scores lie in the range of “very small” to “small”.

An examination of how the variation in cost across different types of provision drives differences in breakeven impacts has shown that it will take considerably larger impacts for full-time early education to offer better value for money over part-time early education because of the considerably higher annual cost. However, relatively small differences in impacts across different types of providers or quality of providers could mean that higher cost options offer better value for money because the variation in cost is quite small.

6. Conclusions

The SEED study will analyse the impacts of early education for two year olds and for three year olds on child development at ages three and four and on school achievement at age seven. This report has estimated the monetary value of impacts on these outcomes using evidence from the existing literature and from new analysis of the National Pupil Database. These estimated monetary returns were combined with estimates of delivery costs from an earlier SEED report to derive estimates of the breakeven impacts, that is, the level of impacts where the monetary value of the impacts just equal the costs of delivery. Estimation of these breakeven impacts provides early insight into whether positive value for money is feasible and into the variation in the size of the breakeven impacts across the different outcomes and types of provision.

The key findings are:

- Improvements in child development at ages three and age four can be linked to later monetary benefits from reduced SEN, truancy, school exclusion, youth and adult crime, smoking and depression and from improved employment rates and earnings. Improvements in KS1 attainment at age seven can be linked to later monetary benefits in reduced SEN, truancy and school exclusion and from higher qualifications leading to higher lifetime earnings.
- The values of similar sized improvements in cognitive development (measured in BAS) and social development (measured in the SDQ) at ages three or age four are quite similar: a change in these outcomes of around half a standard deviation is estimated to have a monetary value of around £4,000. Such changes correspond to around 8.5 points on the BAS scale (which ranges from 10 to 141) or around 2.5 points on the SDQ scale (which ranges from 0 to 40). An improvement of around half a standard deviation in KS1 attainment at age seven is estimated to have a monetary value of around £30,000. Such a change corresponds to a 1.5 increase in the total point score for all KS1 subjects (which ranges from 5 to 20).
- The key driver of the monetary value of the impacts is higher earnings rather than reductions in the costs of Government services and the benefits mainly accrue to individuals. This is primarily because a small impact on earnings operates on high annual amounts for a large number of years for most individuals, while impacts which reduce “problem” outcomes have an effect on a much smaller number of individuals over fewer years and have lower annual amounts of money involved.
- For child development outcomes at ages three and four, the breakeven impacts lie in the range of what might be classified as “small” to “medium”, while those for the KS1 scores at age seven lie in the range of “very small” to “small”. However, it should be noted that impacts at age seven may be smaller than at the earlier ages if the effects fade over time. On the other hand, the effects could grow larger over

time if immediate impacts on other factors such as child health and the home learning environment have later effects on educational achievement. In all cases, the breakeven impacts are within the range of the metric for each outcome.

- An examination of how the variation in cost across different types of provision drives differences in breakeven impacts has shown that it will take considerably larger impacts for full-time early education to offer better value for money over part-time early education because of the considerably higher annual cost. However, relatively small differences in impacts across different types of providers or quality of providers could mean that higher cost options offer better value for money because the variation in cost is quite small.

References

- Action on Smoking and Health (ASH), (2015), *The Economics of Tobacco Fact Sheet*, December http://www.ash.org.uk/files/documents/ASH_121.pdf
- Anders, Y., Sammons, P., Taggart, B., Sylva, K., Melhuish, E. and Siraj-Blatchford, I., (2011), "The influence of child, family, home factors and pre-school education on the identification of special educational needs at age 10", *British Educational Research Journal*, vol 37, issue 3, pp 421-441 <http://www.bbk.ac.uk/psychology/our-staff/academic/edward-melhuish/documents/andersetal2011.pdf>
- Blainey, S. and Paull, G. (2017), *Study of Early Education and Development (SEED): The cost and funding of early education*, Department for Education Research Report DFE-RR552, January [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/586235/SEED - The cost and funding of early education - RR552.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/586235/SEED_-_The_cost_and_funding_of_early_education_-_RR552.pdf)
- Brewer, M., Cattan, S., Crawford, C. and Rave, B., (2016), *Free childcare and parents' labour supply: is more better?*, Institute for Fiscal Studies Working Paper W16/22, November <https://www.ifs.org.uk/uploads/publications/wps/WP201622.pdf>
- Brookes, M., Goodall, E. and Heady, L. (2007), *Misspent Youth, the cost of truancy and exclusion*, New Philanthropy Capital, June <http://www.thinknpc.org/publications/misspent-youth/>
- Carneiro, P., Crawford, C. and Goodman, A., (2011), "The Impact of Early Cognitive and Non-Cognitive Skills on Later Outcomes", University College London, Institute for Fiscal Studies and Georgetown University, American Economic Association 2012 Annual Meeting Conference Paper (Permission to cite granted by authors) https://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&uact=8&ved=0CCCEQFjAAahUKEwiqsZHUypLIAhWpKdsKHUnJAMQ&url=https%3A%2F%2Fwww.aeaweb.org%2Faea%2F2012conference%2Fprogram%2Fretrieve.php%3Fpdfid%3D492&usq=AFQjCNFFSSmJFGf3slZ9Bmas4_XigxJrv&sig2=uaQMochMASyIK8kcKEhhsQ
- Cattan, S., Crawford, C. and Dearden, L., (2014), *The economic impact of pre-school education and quality*, Institute for Fiscal Studies Report R99 <http://www.ifs.org.uk/uploads/publications/comms/R99.pdf>
- Connelly, R., (2013), *Interpreting Test Scores*, Millennium Cohort Study Data Note 2013/1, Institute of Education, University of London, September <http://www.cls.ioe.ac.uk/shared/get-file.ashx?itemtype=document&id=1772>
- Cullis, A., and Hansen, K. (2008), *Child Development in the First Three Sweeps of the Millennium Cohort Study*, Department for Children, Schools and Families, Research Report DCSF-RW077 <http://dera.ioe.ac.uk/8787/1/dcsf-rw077.pdf>

Department for Education (DfE) (2015a), *Special Educational Needs in England: January 2015* <https://www.gov.uk/government/statistics/special-educational-needs-in-england-january-2015>

Department for Education (DfE) (2015b), *Section 251 Budget Data: Budget Summary Level 2015 to 2016* <https://www.gov.uk/guidance/section-251-2015-to-2016>

Department for Education (DfE) (2016), *Primary school accountability in 2016*, DFE-00043-2016, January
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/549568/Primary_school_accountability_in_2016.pdf

Department for Work and Pensions (DWP) (2015), *Benefit and Pension Rates*, April
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/457239/DWP11-benefit-and-pension-rates-april-2015-280815.pdf

Feinstein, L. and Duckworth, D., (2006), *Development in the early years: its importance for school performance and adult outcomes*. Centre for Research on the Wider Benefits of Learning Research Report no. 20, Institute of Education, November
<http://eprints.ioe.ac.uk/5970/1/Feinstein2006Development.pdf>

Gaheer, S. and Paull, G. (2016), *The value for money of children's centre services: Evaluation of children's centres in England (ECCE) Strand 5*, Department for Education Research Report DFE-RR561, July
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/534942/ECCE_Strand_5_Value_for_Money_Analysis_Main_Report.pdf

Hawes, D., J. and Dadds, M. R., (2004), "Australian Data and Psychometric Properties of the Strengths and Difficulties Questionnaire", *Australian and New Zealand Journal of Psychiatry*, 38(8), September, 644-51
<http://journals.sagepub.com/doi/pdf/10.1080/j.1440-1614.2004.01427.x>

Hayward, H., Hunt, E., and Lord, A., (2014), *The economic value of key intermediate qualifications: estimating the returns and lifetime productivity gains to GCSEs, A level and apprenticeships*, Department for Education Research Report DFE-RR398A, December
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387160/R398A_-_Economic_Value_of_Key_Qualifications.pdf

Health and Social Care Information Centre (HSCIC), (2014), *Statistics on Smoking*, October
<http://www.hscic.gov.uk/catalogue/PUB14988/smok-eng-2014-rep.pdf>

HM Revenue and Customs (2016), *Rates and allowances: National Insurance contributions* <https://www.gov.uk/government/publications/rates-and-allowances-national-insurance-contributions/rates-and-allowances-national-insurance-contributions>

HM Treasury (2003), *The Green Book, Appraisal and Evaluation in Central Government*. HM Treasury, London:TSO
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf

HM Treasury (2015), *GDP deflators at market prices, and money GDP: October 2015 (The Blue Book)* <https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-october-2015-the-blue-book>

McCrone, P., Dhanasiri, S., Patel, A., Knapp, M., and Lawton-Smith, S. (2008), *Paying the Price- the cost of mental health care in England in 2026*, King's Fund.
http://www.kingsfund.org.uk/sites/files/kf/Paying-the-Price-the-cost-of-mental-health-care-England-2026-McCrone-Dhanasiri-Patel-Knapp-Lawton-Smith-Kings-Fund-May-2008_0.pdf

National Audit Office (2011), *The cost of a cohort of young offenders to the criminal justice system*, Technical Paper, June https://www.nao.org.uk/wp-content/uploads/2010/12/1011663_technical_paper.pdf

New Economy (2015), *Unit Cost Database (v.1.4)*.
<http://neweconomymanchester.com/our-work/research-evaluation-cost-benefit-analysis/cost-benefit-analysis/unit-cost-database>

ONS (2014), *Qualifications and Labour Market Participation in England and Wales: Economic Activity by Highest Level of Qualification by Sex by Age*, June
<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/2011censusqualificationsandlabourmarketparticipationinenglandandwales>

ONS (2015a), *Population Estimates for UK, England and Wales, Scotland and Northern Ireland, Mid-2014, MYE2_population_by_sex_and_age_for_local_authorities_UK, UK persons*, June
<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland>

ONS (2015b), *Annual survey of hours and earnings, 2015 Provisional Results, Gross Pay*, table 6.7a, November
<http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/pubs/publications/re-reference-tables.html?edition=tcm%3A77-400803>

ONS (2016a), *Labour Market Statistics, Employment, unemployment and economic inactivity by age group (seasonally adjusted)*, Oct-Dec 2015 in table A05 SA, April
<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentunemploymentandeconomicinactivitybyagegroupseasonallyadjusted/a05sa/current>

ONS (2016b), *Population estimates for England and Wales 1961 to 2014*, June
<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/adhocs/005825populationestimatesforenglandandwales1961to2014singleyearofage0to105>

Paull, G. and Xu, X., (2015), *Childcare Policy Options for Wales*, Public Policy Institute for Wales, December <http://ppi.wales.gov.uk/files/2016/02/Childcare-Policy-Options-for-Wales.pdf>

Sullivan, A., Joshi, H., Ketende, S. and Obolenskaya, P., (2010), *The consequences at age 7 of early childhood disadvantage in Northern Ireland and Great Britain*, Institute of Education, London http://www.cls.ioe.ac.uk/library-media%5Cdocuments%5CAge7_early%20childhood_disadvantage.pdf

Sawilowsky, S. S., (2009), "New effect size rules of thumb", *Journal of Modern Applied Statistical Methods*, 8(2), 597–599
http://digitalcommons.wayne.edu/cgi/viewcontent.cgi?article=1003&context=coe_tbf

Walker, I. and Zhu, Y., (2013), *The impact of university degrees on the lifecycle of earnings: some further analysis*, Department for Business, Innovation and Skills Research Paper Number 12
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/229498/bis-13-899-the-impact-of-university-degrees-on-the-lifecycle-of-earnings-further-analysis.pdf

Washbrook, E., (2010), *Early Environments and Child Outcomes: An Analysis* Commission for the Independent Review on Poverty and Life Chances, London: Cabinet Office, December
<http://www.bristol.ac.uk/media-library/sites/ifssoca/migrated/documents/eeco.pdf>

Annex A: Descriptions of cognitive and social development measures

This annex describes the cognitive and social development measures used in chapter 3.

A.1 BAS naming vocabulary at ages 3 and 5

BAS naming vocabulary tests expressive verbal ability. The child is shown a series of pictures of objects and is asked to name them. (Connolly (2013))

A.2 MCS cognitive scores at ages 5 and 7

At age five, the MCS includes the BAS tests for naming vocabulary, pattern construction and picture similarities. The pattern construction element tests spatial problem solving: the child is asked to replicate a design using patterned squares. The picture similarities element tests non-verbal reasoning: the child is shown a row of four pictures and is asked to identify a further congruent picture (Connolly (2013)). However, the cited source (Sullivan et al (2010)) does not explicitly state how these measures are combined to construct the measure of cognitive development at age five used in the paper.

At age seven, the MCS includes the BAS tests for pattern construction and word reading. The word reading element tests educational knowledge of reading: the child is asked to read a series of words presented on a card. In Sullivan et al (2010), three scales were used for the cognitive assessment at age seven: the Pattern Construction and Word Reading subscales from the British Ability Scales (BAS) and the Progress in Maths assessment. The three assessment scales, adjusted for age at the MCS3 interview, were combined into a single index using principal components analysis.

A.3 English picture vocabulary test at age 5

The English Picture Vocabulary Test (EPVT) is a measure of general verbal ability, assessing receptive (i.e. aural) vocabulary. Children are asked to identify one of four pictures which best matches the stimulus word's meaning. The test is made up of 56 items, arranged in ascending order of difficulty. Testing is stopped after the child makes five consecutive errors. (Feinstein & Duckworth (2006))

A.4 NCDS cognitive skills measure at age 7

In Carneiro et al (2011), cognitive skills at age seven are measured as an average of standardised test results in maths, reading, copying, and drawing. The tests were:

- The Southgate Group reading test. In this test, the child was given a choice of five words. On 16 (of 30) occasions, the child was given a picture of an object and had

to ring the word describing that object. On the other 14 occasions, the teacher read out a word and the child had to circle the correct one. One mark was awarded for each correct answer, giving a score between 0 and 30.

- The arithmetic test comprised 10 questions, which the teacher could read to the child. One mark was awarded for each correct answer, giving a score between 0 and 10.
- In the copying test, the child was given six shapes and asked to copy each of them twice. One mark was awarded for each correct attempt, giving an overall score between 0 and 12.
- For the drawing test, the child was asked to draw a picture of a man, which was then awarded a mark out of 100 according to the features that were included.

A.5 Edinburgh reading test and Bristol Friendly maths test at age 10

In Feinstein & Duckworth (2006), reading achievement is measured by the 67 item Shortened Edinburgh Reading Test which examined vocabulary, syntax, sequencing, comprehension, and retention. Items were carefully selected to cover a wide age range of ability from 7 to 13 years in a form suitable to straddle the age 10 cohort. Particular attention was paid to the lower limit to allow a score to be allocated for very poor readers

In the same paper, maths achievement was measured by the “Friendly Maths Test” developed by the University of Bristol. It was piloted in two halves in Bristol primary schools on 11,400 children. It consisted of a total of 72 multiple choice questions and covered the rules of arithmetic, number skills, fractions, measures in a variety of forms, algebra, geometry, and statistics and has a reported reliability of .93.

A.6 NFER-Nelson reading test and NFER-Nelson maths test at age 10

In Anders et al (2011), cognitive attainment at age 10 was measured using the NFER-Nelson Reading Level 2 and Mathematics Age 10 tests. The test scores were age-standardized using the EPPE sample as a reference group.

A.7 SDQ total difficulties score at ages 3, 5 and 7

The Strengths and Difficulties Questionnaire (SDQ) is a brief behavioural screening questionnaire about 3-16 year olds (<http://www.sdqinfo.org/a0.html>). Section A of the questionnaire asks about 25 items on psychological attributes which are divided into five groups: emotional symptoms, conduct problems, hyperactivity/inattention, peer

relationship problems and prosocial behaviour. The first four of these groups (with 20 items) are combined together to generate the total difficulties score. For each item, the parent or adult completing the questionnaire answers whether the statement is (1) not true, (2) somewhat true or (3) certainly true based on the child's behaviour over the previous six months. The 20 items can be summarised:

- **Emotional problems scale:** Often complains of headaches... / Many worries... / Often unhappy, downhearted... / Nervous or clingy in new situations... / Many fears, easily scared
- **Conduct problems Scale:** Often has temper tantrums or hot tempers / Generally obedient... / Often fights with other children... / Often argumentative with adults / Can be spiteful to others /
- **Hyperactivity scale:** Restless, overactive / Constantly fidgeting or squirming / Easily distracted, concentration wanders / Can stop and think things out before acting / Sees tasks through to the end...
- **Peer problems scale:** Rather solitary, tends to play alone / Has at least one good friend / Generally liked by other children / Picked on or bullied... / Gets on better with adults than with other children

A.8 BSAG social skills score at age 7

The Bristol Social Adjustment Guide (BSAG) is used to measure social *mal*adjustment at ages 7 and 11 in the NCDS. Teachers are given a series of phrases describing particular aspects of behaviour (often ranked according to severity) and are asked to underline those that apply to the child. The phrases are grouped into 12 domains: anxiety for acceptance by children, hostility towards children, hostility towards adults, 'writing off' adults and adult standards, withdrawal, unforthcomingness, depression, anxiety for acceptance by adults, restlessness, inconsequential behaviour, miscellaneous symptoms, and miscellaneous nervous symptoms. Each domain contains a different number of phrases, with one point allocated to each sentence that the teacher underlines. In Carneiro et al (2011), the primary measure of social skills was generated by adding together the number of sentences underlined in each of the 12 domains to give a total 'social maladjustment' score. The sign of the score was then reversed and normalised it to have mean 0 and variance 1.

Annex B: Regression results for main NPD analysis

This Annex presents the complete regression results for the NPD analysis presented in chapter 4.

Table 19: NPD regression results for number of years of SEN

Coefficient (standard error)	(1) KS1 only	(2) KS1 with controls	(3) KS1 with controls and female interaction	(4) KS1 with controls and FSM interaction
Total points in all KS1 subjects	-0.060 *** (0.001)	-0.421*** (0.001)	-0.452*** (0.001)	-0.400*** (0.001)
Female		-0.479*** (0.004)	-1.181*** (0.013)	-0.480*** (0.004)
Total points in all KS1 subjects # female			0.067*** (0.001)	
Ever eligible for FSM		0.378*** (0.005)	0.382*** (0.004)	0.948*** (0.005)
Total points in all KS1 subjects # ever eligible for FSM				-0.058*** (0.001)
English as first language		0.312*** (0.009)	0.309*** (0.009)	0.322*** (0.009)
Ethnicity: Asian or Chinese		-0.342*** (0.009)	-0.342*** (0.009)	-0.332*** (0.009)
Ethnicity: Black		-0.052*** (0.010)	-0.053*** (0.010)	-0.050*** (0.010)
Ethnicity: Other or Mixed		-0.070*** (0.009)	-0.071*** (0.009)	-0.067*** (0.009)
SEN at KS1		3.281*** (0.005)	3.263*** (0.005)	3.266*** (0.005)
IDACI rank		-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
KS1 cohort: 2002/03		-0.089*** (0.004)	-0.090*** (0.004)	-0.089*** (0.004)
KS1 cohort: 2003/04		-0.070*** (0.005)	-0.071*** (0.004)	-0.070*** (0.004)
Constant	8.853*** (0.001)	5.890*** (0.013)	6.181*** (0.014)	6.181*** (0.014)
Observations	1,748,620	1,547,514	1,547,514	1,547,514
Adjusted R-squared	0.273	0.591	0.592	0.592

Source: NPD analysis, 2001/02-2003/04 cohorts

Table 20: NPD regression results for number of years of persistent truancy

Coefficient (standard error)	(1) KS1 only	(2) KS1 with controls	(3) KS1 with controls and female interaction	(4) KS1 with controls and FSM interaction
Total points in all KS1 subjects	-0.022*** (0.000)	-0.009*** (0.000)	-0.008*** (0.000)	-0.003*** (0.000)
Female		0.012*** (0.001)	0.037*** (0.004)	0.011*** (0.001)
Total points in all KS1 subjects # female			-0.002*** (0.000)	
Ever eligible for FSM		0.152*** (0.001)	0.152*** (0.002)	0.310*** (0.002)
Total points in all KS1 subjects # ever eligible for FSM				-0.016*** (0.000)
English as first language		0.076*** (0.003)	0.076*** (0.003)	0.079*** (0.003)
Ethnicity: Asian or Chinese		-0.037*** (0.003)	-0.037*** (0.003)	-0.035*** (0.003)
Ethnicity: Black		-0.101*** (0.003)	-0.101*** (0.003)	-0.101*** (0.003)
Ethnicity: Other or Mixed		-0.016*** (0.003)	-0.016*** (0.003)	-0.015*** (0.003)
SEN at KS1		0.033*** (0.002)	0.033*** (0.002)	0.029*** (0.002)
IDACI rank		-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Constant	0.315*** (0.00134)	0.110*** (0.004)	0.099*** (0.005)	0.045*** (0.005)
Observations	586,303	519,941	519,941	519,941
Adjusted R-squared	0.019	0.053	0.053	0.055

Source: NPD analysis, 2003/04 cohort

Table 21: NPD regression results for probability of school exclusion

Marginal effects (standard error)	(1) KS1 only	(2) KS1 with controls	(3) KS1 with controls and female interaction	(4) KS1 with controls and FSM interaction
Total points in all KS1 subjects	-0.009*** (0.000)	-0.003*** (0.000)	-0.003*** (0.000)	-0.006*** (0.000)
Female		-0.038*** (0.000)	-0.019*** (0.001)	-0.038*** (0.000)
Total points in all KS1 subjects # female			-0.002*** (0.000)	
Ever eligible for FSM		0.051*** (0.001)	0.051*** (0.001)	0.008*** (0.001)
Total points in all KS1 subjects # ever eligible for FSM				0.004*** (0.000)
English as first language		0.019*** (0.001)	0.019*** (0.001)	0.019*** (0.001)
Ethnicity: Asian or Chinese		-0.008*** (0.001)	-0.008*** (0.001)	-0.009*** (0.001)
Ethnicity: Black		0.026*** (0.001)	0.026*** (0.001)	0.025*** (0.001)
Ethnicity: Other or Mixed		0.014*** (0.001)	0.014*** (0.001)	0.014*** (0.001)
SEN at KS1		0.011*** (0.001)	0.011*** (0.001)	0.011*** (0.001)
IDACI rank		-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
KS1 cohort: 2002/03		0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)
KS1 cohort: 2003/04		-0.008*** (0.001)	-0.008*** (0.001)	-0.008*** (0.001)
Observations	1,748,620	1,547,514	1,547,514	1,547,514
Pseudo R-squared	0.0222	0.0596	0.0599	0.0609

Source: NPD analysis, 2001/02-2003/04 cohorts

Table 22: NPD regression results for highest qualification

Marginal effects (standard error)	(1) KS1 only		(2) KS1 with controls	
	Fewer than 5 good GCSEs	At least 1 pass at A Level	Fewer than 5 good GCSEs	At least 1 pass at A Level
Total points in all KS1 subjects	-0.065*** (0.000)	0.085*** (0.000)	-0.050*** (0.000)	0.072*** (0.000)
Female			-0.051*** (0.001)	0.067*** (0.001)
Ever eligible for FSM			0.125*** (0.001)	-0.137*** (0.001)
English as first language			0.103*** (0.001)	-0.150*** (0.002)
Ethnicity: Asian or Chinese			-0.079*** (0.001)	0.142*** (0.002)
Ethnicity: Black			-0.096*** (0.001)	0.153*** (0.002)
Ethnicity: Other or Mixed			-0.061*** (0.001)	0.108*** (0.002)
SEN at KS1			0.071*** (0.001)	-0.051*** (0.001)
IDACI rank			-0.000*** (0.000)	0.000*** (0.000)
KS1 cohort: 2002/03			-0.035*** (0.001)	-0.010*** (0.001)
KS1 cohort: 2003/04			-0.027*** (0.001)	0.031*** (0.001)
Observations	1,376,228		1,248,188	
Pseudo R-squared	0.1539		0.2002	

Source: NPD analysis, 2001/02-2003/04 cohorts

Table 23: NPD regression results for highest qualification with interactions

Marginal effects (standard error)	(3) KS1 with controls and female interactions		(4) KS1 with controls and FSM interactions	
	Fewer than 5 good GCSEs	At least 1 pass at A Level	Fewer than 5 good GCSEs	At least 1 pass at A Level
Total points in all KS1 subjects	-0.049*** (0.000)	0.072*** (0.000)	-0.055*** (0.000)	0.077*** (0.000)
Female	-0.045*** (0.003)	0.066*** (0.001)	-0.051*** (0.001)	0.067*** (0.001)
Total points # female	-0.001*** (0.000)	0.000*** (0.000)		
Ever eligible for FSM	0.125*** (0.001)	-0.143*** (0.002)	-0.017*** (0.001)	0.078*** (0.002)
Total points # ever eligible for FSM			0.013*** (0.000)	-0.020*** (0.000)
English as first language	0.103*** (0.001)	-0.150*** (0.002)	0.100*** (0.001)	-0.150*** (0.002)
Ethnicity: Asian or Chinese	-0.079*** (0.001)	0.142*** (0.002)	-0.080*** (0.001)	0.143*** (0.002)
Ethnicity: Black	-0.096*** (0.001)	0.153*** (0.002)	-0.095*** (0.001)	0.151*** (0.002)
Ethnicity: Other or Mixed	-0.061*** (0.001)	0.108*** (0.002)	-0.061*** (0.001)	0.108*** (0.002)
SEN at KS1	0.071*** (0.001)	-0.051*** (0.001)	0.070*** (0.001)	-0.051*** (0.001)
IDACI rank	-0.000*** (0.000)	0.000*** (0.000)	-0.000*** (0.000)	0.000*** (0.000)
KS1 cohort: 2002/03	-0.035*** (0.001)	-0.010*** (0.001)	-0.036*** (0.001)	-0.010*** (0.001)
KS1 cohort: 2003/04	-0.027*** (0.001)	0.031*** (0.001)	-0.027*** (0.001)	0.030*** (0.001)
Observations	1,248,188		1,248,188	
Pseudo R-squared	0.2002		0.2013	

Source: NPD analysis, 2001/02-2003/04 cohorts

Annex C: Results for alternative specifications

Chapter 4 reports estimates of the impact of KS1 attainment measured by the total point score across all KS1 subjects. This Annex reports estimated impacts using three alternative measures of KS1 attainment: whether a pupil achieved the expected level in all subjects; whether a pupil achieved the expected level in all main subjects; and the total point score across all main subjects. Both the simple correlation between KS1 attainment and later life outcomes (Model 1) and the relationship controlling for pupils' background characteristics (Model 2), including gender, ethnicity, SEN status prior to KS1 assessments and socioeconomic status are reported in tables 24 to 27.

Table 24: Associations with alternative KS1 specifications: SEN

	(1) KS1 only	(2) KS1 with controls
Achieved expected level in main KS1 subjects	-5.058*** (0.006)	-3.060*** (0.005)
Achieved expected level in all KS1 subjects	-4.810*** (0.005)	-2.888*** (0.005)
Total points in main KS1 subjects	-1.072*** (0.001)	-0.674*** (0.001)

Source: NPD analysis, 2001/02-2003/04 cohorts

Table 25: Associations with alternative KS1 specifications: truancy

	(1) KS1 only	(2) KS1 with controls
Achieved expected level in main KS1 subjects	-0.148*** (0.001)	-0.069*** (0.002)
Achieved expected level in all KS1 subjects	-0.142*** (0.001)	-0.065*** (0.002)
Total points in main KS1 subjects	-0.034*** (0.000)	-0.015*** (0.000)

Source: NPD analysis, 2001/02-2003/04 cohorts

Table 26: Associations with alternative KS1 specifications: exclusion

	(1) KS1 only	(2) KS1 with controls
Achieved expected level in main KS1 subjects	-0.053*** (0.000)	-0.018*** (0.000)
Achieved expected level in all KS1 subjects	-0.053*** (0.000)	-0.018*** (0.000)
Total points in main KS1 subjects	-0.014*** (0.000)	-0.006*** (0.000)

Source: NPD analysis, 2001/02-2003/04 cohorts

Table 27: Associations with alternative KS1 specifications: highest qualification

	(1) KS1 only		(2) KS1 with controls	
	Fewer than 5 good GCSEs	At least 1 pass at A Level	Fewer than 5 good GCSEs	At least 1 pass at A Level
Achieved expected level in main KS1 subjects	-0.333*** (0.000)	0.419*** (0.001)	-0.208*** (0.000)	0.284*** (0.001)
Achieved expected level in all KS1 subjects	-0.320*** (0.000)	0.398*** (0.001)	-0.203*** (0.000)	0.275*** (0.001)
Total points in main KS1 subjects	-0.101*** (0.000)	0.134*** (0.000)	-0.075*** (0.000)	0.111*** (0.000)

Source: NPD analysis, 2001/02-2003/04 cohorts

Chapter 4 reports estimates for the highest level of qualification achieved measured using three categories: fewer than 5 GCSEs at A*-C; at least 5 GCSEs at A*-C but no A Levels; and at least 1 pass at A Level. These categories were used to align the analysis with prior estimates of the impact of qualifications on earnings (Cattan et al. 2014). In this Annex, results from an alternative specification, using 5 GCSEs at A*-C including English and Mathematics are reported in table 28.

Table 28: Associations with alternative highest qualification specification

Marginal effects Independent variable	(1) KS1 only		(2) KS1 with controls	
	Fewer than 5 good GCSEs including English and Maths	At least 1 pass at A Level	Fewer than 5 good GCSEs including English and Maths	At least 1 pass at A Level
Total points in all KS1 subjects	-0.102*** (0.000)	0.090*** (0.000)	-0.085*** (0.000)	0.075*** (0.000)
Female			-0.054*** (0.001)	0.067*** (0.001)
Ever eligible for FSM			0.140*** (0.001)	-0.139*** (0.001)
English as first language			0.149*** (0.001)	-0.156*** (0.002)
Ethnicity: Asian or Chinese			-0.113*** (0.001)	0.149*** (0.002)
Ethnicity: Black			-0.144*** (0.001)	0.169*** (0.002)
Ethnicity: Other or Mixed			-0.094*** (0.001)	0.113*** (0.002)
SEN at KS1			0.087*** (0.001)	-0.040*** (0.001)
IDACI rank			-0.000*** (0.000)	0.000*** (0.000)
KS1 cohort: 2002/03			-0.018*** (0.001)	-0.005*** (0.001)
KS1 cohort: 2003/04			-0.024*** (0.001)	0.026*** (0.001)
Observations	1,567,609		1,435,427	
Pseudo R-squared	0.1759		0.2217	

Source: NPD analysis, 2001/02-2003/04 cohorts

Annex D: Description of provider type and quality

PVI type settings include private, voluntary and independent settings defined as:

- Private – privately owned provision, including full day care and sessional care; ownership by an individual or by a larger organisation/chain; and that based on school sites and elsewhere.
- Voluntary – provision run by a charity or voluntary management committee on a not-for-profit basis, including full day care and sessional care; unincorporated and incorporated (and registered with Charity Commission); and that based on school sites and elsewhere.
- Independent – early years provision run by an Independent School and delivered on site.

Maintained settings include:

- Nursery Class – a maintained early years class within a primary school with a qualified teacher present.
- Maintained Nursery School – a maintained school, purpose built and specifically for children in their early years with a qualified teacher present.
- Local Authority nursery – full day care or sessional provision delivered by the Local Authority with staff members employed by the Local Authority.
- Children’s Centre - governed and managed in various ways by the Local Authority, by the School Governing Body (if on a school site), by a charity or by a private provider.

A childminder is defined as:

- Childminder – a person whose job is to take care of other people’s children in his or her own home

Quality is an age-specific average based on the average of two measures (ITER and SSTEWE) for two year olds and on the average of three measures (ECERS-R, ECERS-E and SSTEWE) for three year-olds as collected in the SEED study of settings. It is divided into three discrete categories of low quality (<4.5), medium quality (>=4.5 and <5.5) and high quality (>=5.5). The Early Childhood Environment Rating Scale (ECERS-R) and its extension (ECERS-E) are designed to evaluate quality of provision for children aged 2½ to 5 years in centre-based settings. The Infant Toddler Environment Rating Scale (ITERS) is the partner scale for the 0 to 2½ years age range. Both the ECERS-R and ITERS-R contain a wide range of statements or ‘indicators’ with which to evaluate the quality of the early years environment in its broadest sense. The Sustained Shared Thinking and Emotional Well-being (SSTEWE) is a new scale which considers practice that supports children in developing skills in sustained shared thinking and emotional well-being, as well as developing strong relationships, effective communication and aspects of self-regulation.



Department
for Education

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Reference: DFE- RR665

ISBN: 978-1-78105-733-9

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