

# Early education and children's outcomes: How long do the impacts last?

Alissa Goodman and Barbara Sianesi

Institute for Fiscal Studies<sup>1</sup>

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## Abstract

We evaluate the effects of undergoing any early schooling (before the compulsory starting age of 5) and of pre-school on a cohort of British children born in 1958. In contrast to most available studies, we are able to assess whether any effects on cognition and socialisation are long-lasting, as well as to estimate their net impact on subsequent educational attainment and labour market performance.

Controlling for a particularly rich set of child, parental, family and neighbourhood characteristics, we find some positive and long-lasting effects from early education. Specifically, pre-compulsory education (pre-school or school entry prior to age 5) was found to yield large improvements in cognitive tests at age 7, which, though diminished in size, remained significant throughout the schooling years, up to age 16. By contrast, attendance of pre-school (nursery or playgroup) was found to yield a positive but short-lived impact on test scores. The effects on socialisation appear to be more mixed, with adverse behavioural effects from parental reports at age 7 persisting, for pre-school participants, up to age 11.

In adulthood, pre-compulsory schooling was found to increase the probability of obtaining qualifications and to be employed at 33. For both pre-compulsory education and pre-school *per se* we found evidence of a marginally significant 3-4% wage gain at 33.

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# 1. Introduction

Early childcare and pre-school policies have become an important focus of the government's strategy for improving the well-being of children, either through the enabling effect that childcare has on allowing parents to work, or through other more direct effects of early education on children. The aim of this paper is to shed light on the question of how effective early pre-school and schooling is for improving the well-being of children, and whether any impacts are likely to be long-lasting. In doing so, we add to a well-established literature both from the UK and around the world (especially the US), addressing itself to this question.

We add to this literature in two ways. First, by using data from the National Child Development Study (NCDS), a single cohort of people born in 1958, we can control for a particularly large set of parental, family, individual, and neighbourhood characteristics in assessing the effects of early education on children. Second, by considering a cohort that has now reached adulthood, rather than a contemporary cohort, we are able to assess whether any effects we find are long-lasting. Most studies, which look at early education amongst contemporary cohorts of children are unable to be informative as to the longer-term effects. For example the EPPE study (see section 2) has only so far followed children as far as age 7, whereas the NCDS is currently available up to age 42.

In this paper we consider the returns to two different early education 'treatments': first we consider the impact of a child obtaining any early education prior to the age of 5, whether this takes place in a school setting (through early entry to primary school), or in a pre-school setting such as state-maintained or private nursery, or playgroup. This answers the question of whether any formal human capital intervention before the age of 5 is beneficial for child outcomes. Second, we restrict our treatment of interest to attendance at pre-school only, answering the question of whether attendance at nursery or other establishments before entering primary school has short or long-term effects.

We consider a wide range of outcomes, from cognitive development, as measured by a series of tests taken by the children at ages 7, 11, and 16, to socialisation, derived from both parental and teacher assessments of social skills also at 7, 11, and 16, to educational attainment and labour market outcomes up to the age of 42.

Our aim is to consider the *total policy* effects of early schooling, without holding the value of other inputs constant. By doing this we are aiming to capture the contribution of the schooling itself, and of any other concurrent and subsequent family and school inputs that change *as a result of early education participation*. In estimating these policy effects we use ordinary least squares (OLS), fully interacted linear matching, and propensity score matching.

To assess how 'economically significant' our estimated effects of early schooling are, throughout we compare their magnitude to the influences that other factors have on children's cognitive and social development – such as the education and social class of the parents, and whether the child grew up in families experiencing severe difficulties such as alcoholism, or mental illness. We also consider whether there are different effects for sub-groups of the population – for example whether children from lower social class backgrounds gain more or less from early schooling, and whether there are differential effects for boys or girls.

The paper proceeds as follows: Section 2 reviews previous research in this area and places our work in its context. Section 3 describes the data we use, the early education 'treatments' we consider and the outcomes against which we assess their benefits. Section 4 discusses our methodology. Section 5 describes patterns of participation in various forms of early education, looks at raw differences in performance, summarises the main determinants of early educational investments, and presents all the results. Section 6 concludes.

## 2. A review of the literature and our contribution

A prolific body of research on early childhood programmes in the US focuses on the effects of programmes intended for disadvantaged children, in particular from ethnic minority, low-educated, single-parent or low-income families. Such programmes include small-scale model, or ‘exemplary’ programmes such as the High/Scope Perry Pre-school Project, as well as ongoing, large-scale public programmes such as Head Start. An important strength of this research from an evaluation point of view is that often these programmes have been evaluated experimentally, that is their services were randomly allocated to some children, with some other children being randomly assigned to a control group. Albeit not completely free from methodological problems<sup>2</sup>, the evidence from these studies has consistently pointed to short-term cognitive improvements as well as long-term gains in terms of academic achievement, reduction in special education placement, employment, earnings and crime. In addition, parents were positively affected as well, with benefits being reported in terms of maternal employment and increased parental involvement in their child’s school. See e.g. the reviews by Currie (2001), Waldfogel (1999), Karoly et al. (1998) and Barnett (1995).

Although there is thus ample evidence from the US robustly documenting the benefits from high-quality, intensive early education interventions for disadvantaged children, this evidence tells us nothing about the effectiveness of ordinary community services (a different ‘treatment’) on children from all backgrounds (a different target population). There is in fact much less consensus about the effectiveness of typical preschool programmes on ordinary children, on which the evidence, though growing, is more limited as well as more controversial. This is because even in the US, studies of larger and more representative programmes have had to rely on a non-experimental design and have typically been able to include only a few regressors to control for selection issues. A small number of studies have been able to address this issue by using rich data, exploiting either the detailed information available in the British cohort studies (NCDS and BCS70) or data specifically collected on preschool-age children (like EPPE in the UK or NICHD in the US).

The 1970 British Cohort Study (BCS70) has extensively been explored in the book by Osborn and Milbank (1987), whose study has been viewed as the ‘most statistically convincing’ and described ‘as the first major evaluation of British preschool education’ (Cleveland and Krashinsky, 1998). Based on a sample of 8,500 children with additional information merged in from a census of all preschool institutions, they separately assess the effects on cognitive and behavioural development at age 5 and 10 of several different types of ordinary preschool programmes, finding similar types of effects for nearly all. Based on ‘analyses of variance’ controlling for a number of important socio-economic and family factors, they find that pre-school generally boosts cognitive attainment at ages 5 and 10. In terms of problem behaviour, pre-school attendance was found to have no effect at age 5 but to increase some types of behavioural problems at 10, in particular conduct disorder, although the latter associations were relatively weak. The study also found weak evidence for the benefits of nursery education being slightly greater for socially disadvantaged children, although this difference was small compared to the general benefit of pre-school for all children.

The BCS70 has also been looked at by Feinstein *et al.* (1998), together with the NCDS. They consider the effects of hours spent in (any type of) childcare relative to being neither in pre-school nor with the mother (i.e. relative to being cared for by a relative or childminder) on cognitive ability tests and on measures of social adjustment (at 7, 11 and 16 for the NCDS; at 5 and 10 for the BCS70). For the 1958 NCDS cohort, pre-school was found to have no effects on social adjustment and positive effects on cognitive tests up to age 11 (particularly on math skills), which then fade away by age 16. For the 1970 BCS70 children, by contrast, the evidence is one of marginally worse

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<sup>2</sup> In particular, small sample sizes, short follow-up periods and non-random attrition; see e.g. the discussion in Barnett (1995).

social adjustment and reduced vocabulary at 5, worse reading skills at 11, and no effects on math skills. The authors thus conclude that ‘over about a decade (1962-1973), the pre-school experience appears to have ceased to improve test scores in children as they enter secondary school’.

Methodologically, this study is very ambitious, in that the authors try to estimate the cognitive and non-cognitive development production functions, allowing the choice of pre-school hours, the allocation of maternal time as well as intermediate children’s performance to be endogenous. It is however not likely that the results are very robust given how hard it is to identify structural parameters without enough exogenous variations for all endogenous (initial and intermediate) inputs. By contrast, in this paper we aim at identifying policy parameters, that is the *total* effect of pre-school on achievement (i.e. *not* holding other inputs and intermediate outcomes constant).

The second strand of non-experimental research is based on recent ‘ad hoc’ studies, which specifically sample preschool-age children, collect relevant background information and follow both their subsequent pre-school experience and their subsequent cognitive and behavioural development.

In the US, the National Institute of Child Health and Human Development initiated the NICHD Study of Early Child Care, a longitudinal study to determine the relationship between children’s childcare experiences and their developmental outcomes from infancy to school age. In 1991, over 1300 newborn children across 10 sites throughout the country were sampled; they were then followed up and are currently in their 7<sup>th</sup> year in school. Children in higher-quality childcare arrangements were found to perform better on tests of cognitive skills and language ability than children in lower-quality care. However, children who spent more time in childcare were found to display more behavioural problems<sup>3</sup>, particularly aggression, at 4.5 years and later in kindergarten than children who spent less time.<sup>4</sup> The findings from the NICHD study thus caution against overarching conclusions about whether childcare harms or benefits children; rather, childcare effects crucially depend on the characteristics of that care (its quality, continuity and intensity), as well as on the characteristics of the child and family (cf. Waldfogel, 1999).

Another ‘ad hoc’ US study is the newly available Early Childhood Longitudinal Study – Kindergarten Class of 1998-99 (ECLS-K). This is a large and nationally representative sample of children who entered kindergarten in the fall of 1998, and is currently available through the spring of 2000, when most children are completing first grade. Magnuson *et al.* (2004) use this data to address a similar question as NICHD. However they also are able to test the robustness of their findings to potential selection on unobserved variables by instrumenting prekindergarten attendance with state expenditures on these programmes. They find that prekindergarten increases math and reading skills at kindergarten entry, but is also associated with an increase in behavioural problems. Furthermore, while the cognitive gains largely dissipate by the spring of first grade, the negative effects on classroom behaviour do not. The largest and most lasting academic gains were found for disadvantaged children.

The British counterpart to NICHD, the Effective Provision of Pre-school Education (EPPE) is a longitudinal study begun in 1996 and funded by the Department for Education and Skills. Over 3,000 children were sampled from a range of pre-school providers, and then followed from the start of pre-school (age 3 years plus) through to primary school entry and across the infant period of primary education. An additional small sample of 314 ‘home’ children was recruited at entry to primary school to act as comparison for the pre-school sample. The study found a positive impact of pre-school, both on cognitive and overall social development, at entry to primary school (age rising 5 years) and at the end of Year 1 in primary school (age 6). At the end of Key Stage 1 (age 7), the

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<sup>3</sup> These were rated by caregivers, mothers and kindergarten teachers.

<sup>4</sup> In particular, the share of children with high scores was found to rise with the increase in the number of hours spent in childcare. Note though that only a minority of the children had a high score on behaviour problems.

cognitive gains had been reduced in size but were still present, while the impact on social behaviour had faded out. The exception to the latter was that very long durations in pre-school were associated with higher levels of anti-social behaviour at entry to primary school and still visible at age 7.

The great advantage of studies of the kind of EPPE, NICHD and ECLS-K is that they look at the effects of relatively recent pre-school provision, which should closely reflect current provision; naturally, the price they have to pay is in terms of their ability of assessing only extremely short-term outcomes (up to age 7).<sup>5</sup>

This is where our paper fits in: as we have briefly reviewed, while results for the impact of early education on cognitive development have been consistently positive, existing studies have produced mixed results for behavioural development, in particular that early education may have adverse effects on children's behavioural adjustment. Although cognitive outcomes have traditionally received most attention in the economics literature, the importance of non-cognitive (or social) skills as determinants of educational attainment and labour market success has recently been increasingly appreciated. In such a context, without access to data on long-term outcomes, it remains unclear whether the uncovered increases in relatively low levels of problem behaviours will be consequential for subsequent schooling and labour market outcomes (an issue raised as well by Magnuson *et al.*, 2004).

Our paper addresses this directly, by assessing both the *persistence* of any given effect (i.e. whether 'skills beget skills' or whether the 'home' children rapidly catch up once in school), and also by looking at the *long-term, net* benefits of pre-school education (i.e. assessing how gains and losses in different dimensions are traded-off in the labour market), giving us a much fuller understanding of the longer-run returns to investments in early education.

### **3. Data, treatments and outcomes of interest**

#### **3.1 Data**

Among the uniquely rich data from the British cohort studies, the National Child Development Survey (NCDS) keeps detailed longitudinal records on all children born in a single week in March 1958. We make extensive use of each sweep of the study, starting with the baseline 1958 Perinatal Mortality Survey (birth) survey, in which information was obtained from the mother and from medical records on characteristics of the mother (age, weight, marital status, education, paid occupation, previous abortions or other complications, smoking behaviour, social class of mother's father), on the child father's social class and age, and on the child (gender, birth weight, any serious illness). The 1965 follow-up contains information from the parent, head teachers and class teachers, the schools health service and the child, and allows us to identify the type of pre-school the child attended, as well as cognitive and behavioural outcomes at age 7, the latter assessed both by the teacher and by the parent. Subsequent sweeps are used to gather information on outcomes: indicators of cognitive and behavioural development again at age 11 and 16, educational achievement, interests and attitudes, and labour market outcomes (wages and employment status) in adulthood (at ages 23, 33, and 42).

We further coded in information about state maintained provision of nursery places at the Local Authority (LA) level, taken from Blackstone (1971, Appendix 4, originally from the Department for Education and Science), as well as other information about LA characteristics from the 1961 Cen-

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<sup>5</sup> Furthermore the number of children involved in these studies is typically quite small, which reduces a study's statistical power to detect effects, particularly for specific sub-groups like disadvantaged children.

sus and from the Institute of Municipal Treasurers and Accountants' Education Statistics (1958 and 1965).

In terms of sample selection, we exclude anyone not present in the birth survey<sup>6</sup> as well as Scottish children, the latter both because their school system differs in a number of respects from the English one and because for them we would not have all the information at the Local Authority level that we have for England and Wales. Finally, in this analysis we do not consider day nurseries nor children attending them.<sup>7</sup>

We are left with a sample of 12,513 children with non-missing pre-school information. This sample size is larger than experimental studies in the US or other 'ad hoc' studies discussed in the section above.

### **3.1 Treatments**

Our research addresses itself to two questions:

- 1) How long do the effects of pre-school or early education on a given outcome, say test scores, persist?**
- 2) What is the *net* effect of pre-school or early education on other subsequent outcomes (such as educational attainment or wages)?**

In order to answer these questions we need to define carefully what is the 'treatment' of interest. One can think of early education encompassing both pre-school and early school entry, where:

- Pre-school education is defined as taking place in establishments regularly attended by the child outside his or her own home in order to participate in educational activities, before starting school. These include formal centre-based care in the form nurseries (both Local Authority or independent), and other more informal settings such as playgroups, which also give children the opportunity to interact with peers and typically expose children to learning experiences.
- Early school entry refers to starting school before the autumn term when a child turns 5, that is before reaching compulsory school age. Note that, having being born in the same calendar week, the NCDS children will have received a different amount of schooling by the time their outcomes are measured (e.g. tests at 7) depending on when they started formal schooling.

In the light of this we consider the following two broad types of investments in early education:

#### **i) The effects of pre-compulsory education**

We define '*pre-compulsory education*' to encompass any form of education prior to the statutory school-starting age of 5. This includes both pre-school education and early school entry. We thus

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<sup>6</sup> For the first three follow-ups, the original birth cohort was augmented with immigrants to Britain born in the relevant week.

<sup>7</sup> At the time of the NCDS 1958 birth cohort, day nurseries were distinct from other forms of early schooling. Their primary aim was care and protection of young vulnerable children rather than education. Intended for children whose families have come to the attention of Social Services Departments, their client group was primarily made up of the most underprivileged children living in chronic social deprivation, in particular in troubled homes, very low-income or one-parent households, or who have some form of handicap. Not only is this a highly selective subgroup, but since we try to distinguish as cleanly as possible environments where the child is receiving some form of education from those where s/he is simply being minded, in this analysis we do not consider day nurseries nor children attending them.

look at the effect of any type (or combination) of early schooling compared to not receiving any form of pre-school and starting school at the statutory age of 5.

## ii) The effects of pre-school education

We also consider the effects just of pre-school education, either private or LA nursery, or play-group, without taking into account whether the child subsequently went to school early. The comparison state includes alternatives such as staying at home, as well as starting school early.

This second definition of treatment is comparable to that used in other studies, in particular Osborn and Milbank (1987) and the more recent EPPE evaluation (see also the definition in Blackstone, 1971, p.92). The former study explicitly excluded infant classes from their pre-school classification.<sup>8</sup> The EPPE study also restricts itself to an analysis of strictly pre-school settings and does not consider the effects on children of entering school before the age of 5. More specifically, the children entered the EPPE study at different ages, but were tested after having received the same amount of education (i.e. at entry to primary school, at the end of Year 1 and at the end of Year 2).<sup>9</sup>

## 3.2 Outcomes

The NCDS allows us to analyse the effects of early educational investments on an exceptional variety of outcomes, measured from early childhood to mature adulthood. Being able to look at the effects of nursery participation on such a range of diverse dimensions of puts us in the rare position of attaining a very full picture of what type of skills and behaviours are affected by early education. We consider the impact of early education on a variety of dimensions:

### (a) Cognitive development

We look at cognitive functioning when aged 7, 11 and 16. We consider a summary measure of overall cognitive achievement, and separate measures of mathematical skills, language/reading skills, and, for the younger ages, verbal and non-verbal general ability and motor-perceptual ability (copying design test, a non-verbal test of cognitive ability based on spatial awareness and eye-hand coordination). Having separate tests for different aspects of cognitive development allows us to evaluate which aspect is receptive to pre-school influences.

### (b) Social/behavioural development

Although cognitive skills have traditionally received most attention in the economics literature, the importance of behavioural and attitudinal skills as determinants of attainment and labour market outcomes has been increasingly recognised. In parallel to cognitive development, we thus look at a number of measures of social adjustment at 7, 11 and 16. A rather unique feature of our data is that we can consider social behaviour assessed by three different people very close to the child: the elementary school teacher, the secondary school teacher and the mother.<sup>10</sup>

At ages 7 and 11, the teacher assessed the child's behavioural deviance and maladjustment using the *Bristol Social Adjustment Guides* (BSAG), a test for measuring the extent of disturbance in chil-

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<sup>8</sup> They however also briefly consider the separate effect of early school start conditional on a child's pre-school experience.

<sup>9</sup> National assessments are not age-standardised; the EPPE study controlled for the child's age in months when estimating impacts.

<sup>10</sup> Magnuson *et al.* (2004) for instance, only have teacher's ratings, and can only speculate that 'classroom behaviour is not necessarily indicative of behaviour in other settings, so children attending prekindergarten might not exhibit higher levels of aggression at home'.

dren's social adjustment and behaviour. It is designed to be as free as possible from personal judgement and tests a variety of personal and interpersonal dimensions, resulting in an overall assessment of maladjustment.

At 16, the teacher was asked to report on the child's behaviour by answering a set of specific questions related to: aggressive behaviour (e.g. if the child fights frequently, destroys things, is irritable, or is resentful/aggressive when corrected), peer relationships (whether not much liked by other children, bullied by other children, or bullies other children), other types of antisocial behaviour (is often disobedient, tells lies or steals things) and socio-emotional development (whether the child often worries, is miserable, cannot settle more than a few moments, has difficulties concentrating, is upset by new situation or is unresponsive and apathetic). Very similar questions were asked also to the parent at all ages; in addition to an overall parental rating, for age 7 we have grouped the answers into those relating more to 'interpersonal skills' and those relating to 'self-control skills'.

We finally consider the potential effects on 'objective' measures of social maladjustments in terms of pre-/delinquent behaviour at 11 and offending behaviour at 16 (trouble with police, having been to court), reported by the teacher and the parent respectively.

#### (d) Educational attainment

School outcomes are measured by special education, the attainment of any qualification beyond basic level (i.e. above Level 1) and the achievement of higher qualifications (at Levels 4 or 5). Any effect on academic functioning in terms of educational attainment includes the effects on (a) cognitive development, (b) socialisation.

#### (e) Labour market success

We aim to establish whether there is evidence of any continuing pre-school influence in adulthood in terms of economic success on the labour market, as measured by employment status at 33 and 42 (irrespective of whether as an employee or a self-employed) and wages at 33 and 42.<sup>11</sup>

It should be noted that section 5 presents our results on just a subset of these outcomes; however all are available on request from the authors.

## 4. Methodology

### 4.1 *The evaluation problem*

We are interested in the causal effect of early education on the cognitive and behavioural development of those children attending early education (the so-called average effect of treatment on the treated – ATT).<sup>12</sup> Note also that we are concerned with the *total* effect of attending nursery on achievement, that is, *not* holding other family and school inputs constant.<sup>13</sup> Such effects thus en-

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<sup>11</sup> We do not specifically look at labour market outcomes at 23 since this might produce an incomplete and possibly misleading picture given the number of those who have just completed higher education by that age.

<sup>12</sup> This is the parameter of interest when the treatment, in our case pre-school attendance, is voluntary, as well as the parameter required for a cost-benefit analysis of pre-school.

<sup>13</sup> By contrast, to be able to answer the question of how an exogenous change in nursery attendance alone, that is *holding all other and subsequent inputs constant*, would affect cognitive and non-cognitive achievement, one would need to estimate the structural parameters of the cognitive and non-cognitive development production function, a task which is very hard to accomplish credibly (see the review by Todd and Wolpin, 2003, and, for an attempt in this area, Feinstein *et al.*, 1998).

compass the indirect contribution of any other concurrent and subsequent family and school inputs that change *as a result of nursery participation* and in turn affect cognitive development.<sup>14</sup>

In order to estimate the impact of pre-school on an outcome  $Y$  such as test scores for the children who attended pre-school, one would ideally need to compare the average test score of these children to the average test score that these *same* children would have achieved had they not attended pre-school. However, since a given child either attends pre-school or does not, the average test score that pre-school children would have achieved had they not attended pre-school remains an unobserved counterfactual. The evaluation problem consists in providing unbiased estimates of this average counterfactual through the use of appropriate methods and usually untestable assumptions.

Trying to estimate the counterfactual no-pre-school outcomes for pre-school children with the observed mean outcome of home children will yield unbiased estimates of the impact of pre-school only if children attend pre-school based on characteristics which are unrelated to outcomes ('random assignment'). By contrast, one might in general expect families to send their children to pre-school on the basis of characteristics that also influence subsequent children's outcomes. The so called 'selection bias' problem is that some of the difference in outcomes between nursery and non-nursery children is attributable to these pre-nursery differences, not to nursery itself.

## 4.2 Selection on observables

If we have information detailed enough to capture *all* the outcome-relevant differences between children attending pre-school and children not doing so, we could adjust the raw comparison for those pre-nursery differences, thus obtaining unbiased estimates of the causal impact of nursery.

Before describing in some detail the extensive individual, family and local neighbourhood information we have assembled in order to credibly control for selection into nursery education, we briefly sketch the estimation methods we use that rely on the selection-on-observables assumption.

A standard OLS regression controlling *linearly* for the set of observable characteristics and pre-school attendance may suffer from two potential sources of bias from observables alone. First, if the true model were non-linear in terms of the characteristics, the OLS estimate of the pre-school effect would in general be biased. Secondly, this regression constrains the impact to be homogeneous, i.e. the same for all children; if, by contrast, the effect varies according to some of the child's characteristics, OLS will not in general recover the ATT. Both these biases are exacerbated if some children fall outside of the so-called *common support* of the observables, that is if there are children participating in nursery for whom there are no comparable children in the non-participating sample. In this case, performing OLS might hide the fact that the researcher is actually comparing incomparable children by using the (linear) extrapolation.

In contrast to standard parametric methods like OLS, matching is robust in the sense that it does not restrict at all the way in which the effect of early education may vary according to individual char-

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<sup>14</sup> An example of indirect effects that would be reflected in our estimates relates to mother's labour supply. Mothers of children at nursery may be induced to go back to work and thus generate more financial resources but also change the amount (and possibly quality) of time they spend with their child. If the time that a mother spends with her child is important for child outcomes and (harder) working mothers do not have as much time to spend with their children, this indirect negative effect might partly offset the indirect benefits arising from extra income. Parents might further adjust their inputs, e.g. via more quality time, which would reduce the indirect negative effect of less time being available for the child. The net influence of all these various indirect effects could thus either reinforce or reduce the ceteris paribus effect. The policy effect is simply the overall effect of nursery attendance, including how parents on average respond.

acteristics. In addition, the focus of matching methods is on the careful choice of an appropriate comparison group.

More specifically, if there are nursery children who are not comparable to anyone in the home group, they are dropped from the analysis. Matching then involves explicitly selecting and pairing to each nursery child a home child with the same characteristics, or, more generally, attaching appropriate weights to the observations in the home group, so as to realign the distribution of characteristics in the home group to the one in the group of nursery participants. It is important to note that one can easily check how well matching has balanced the available observables between the two groups. If balancing cannot be achieved, the researcher needs to accept the fact that the two groups being compared are simply too different in terms of the observables and that there simply is not enough information in the available data to achieve sufficiently close – and thus reliable – matches.

The boundary between OLS and matching is a thin one; nothing prevents the researcher from bringing the OLS estimate closer and closer to the matching one by imposing common support before running the regression as well as by specifying an increasingly flexible OLS model. In particular, one can allow the nursery effect to vary according to each observable characteristic and thus estimate the ATT via OLS regression by implementing a fully interacted linear regression model in which the nursery indicator is interacted with *each* one of the observable variables. An additional advantage of this specification is that we can actually test for the presence of heterogeneous effects.

If no heterogeneity in impacts is found, the estimate of the nursery effect from simple OLS will thus basically coincide with the one from the fully interacted model. If in addition the two groups of interest can be selected so as to be comparable (i.e. there is no serious common support problem and matching can achieve a good balancing of characteristics), both sets of estimates will be very close to the one from the matching estimator. As we will see in Section 5, this often turns out to be the case in our application.

But how credible is the selection-on-observables assumption in our application? Given that we need to capture all those factors that jointly determine pre-school attendance *and* children's cognitive and social development, the nature, extent and accuracy of the available observables are crucial for the credibility of our estimates. The NCDS birth cohort provides a uniquely rich source of information in this regard.

Inputs into a child's early process of cognitive and non-cognitive development comprise the child's hereditary endowment of mental capacity, the local characteristics and amenities of the environment the child is growing in, and parental and family inputs. The latter type of inputs include parental resources such as time or income, their allocation among the children within a family, the more general type of family and learning background offered to the child and, most importantly to our purposes, the choice to send or not the child to pre-school. Table 5.1 summarises the type of information we can control for in the NCDS combined with Local Authority-level data. Such exhaustive controls are direct or proxy variables for the following four groups of factors.<sup>15</sup>

#### i) The child

In addition to gender, we control for the child's health status at birth through relative birth weight and any serious illness noted at birth<sup>16</sup>; breastfeeding is also included in that it is generally viewed as important for early child development. Belonging to a non-white ethnic group and English not

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<sup>15</sup> The variables we control for are all predetermined variables, that is not themselves influenced by nursery attendance, since conditioning on them would block out part of the full nursery effect.

<sup>16</sup> Rh incompatible; severe jaundice (serum bilirubin over 14mgm.cc); convulsions, cerebral irritation or cyanotic attacks; congenital malformation; hypothermia; respiratory disease; infection or pyloric stenosis.

being the mother's usual language with the child should reflect variations in language acquisition and language spoken at home. To proxy the child's genetic endowment, in addition to these factors we control for key measures summarising the child's early development prior to pre-school age: the presence of disability, whether the child has attended a welfare clinic under 1 year of age, whether he or she is not walking alone by 1.5 years, not speaking by 2 years or incontinent by day after 3 years.

## ii) The parents

In addition to summary indicators of the pregnancy history (interval between marriage and first birth and an indicator of how 'difficult' the child was to obtain by combining past miscarriages, neonatal deaths or complications in pregnancy), this set of variables includes various proxies for *parental quality* and hence for the quality of parental inputs to the child's development.

As for parental health and demographic characteristics, we control for father's and mother's age (older mothers may have different attitudes towards children's needs), mother's smoking behaviour (both prior and during pregnancy), mother's obesity and her region of birth. To measure variation in the quality of time parents devote to children and to proxy material resources, we also use social class of the father and both of the maternal and paternal grandfathers. Parental human capital should capture the value parents are likely to attach to the education of their child, as well as the more general quality of parental time. In addition to the typical measure in terms of mother's and father's years of completed schooling, we have created indicators of whether the mother reads the newspaper most days as well as books most weeks, and similarly for the father.

Several indicators of early maternal employment are likewise crucial to control not only for family financial resources, but also for the mother's work propensity (or necessity). In particular, we control for her labour supply and social class at pregnancy in terms of her type of job, the intensity of the work commitment and how far into the pregnancy she worked.

## iii) The home environment

The home and learning environment during the formative first years of a child is likely to be critically related to early child education as well as cognitive development and behaviours.

To capture the nature of family life in its essence, we use a selected range of variables from those that were recorded by the health visitor<sup>17</sup>: whether in the family there were any physical illness or disability; any mental illness, neurosis or mental sub-normality; difficulties relating to divorce, separation or desertion; domestic tensions; in-law conflicts; alcoholism or any other serious difficulty affecting the child's development.

In addition to these important factors reflecting the emotional, psychological, financial and more general the overall climate of the family in which the child is growing up, we use proxies for the available quantity of *parental time*: whether the child has a twin, the child's birth order, the presence of any older brother, any older sister, or a close sibling (i.e. the child was born less than 2 years after the sibling) and family size. The received evidence is in fact that large family size is associated with an increased risk of problem behaviour and poorer cognitive development (Osborn and Milbank, 1987).

Together with family structure and size, parental marital status is an important variable to reflect how parental and family resources (both time and income) are allocated among children within a same family. Furthermore, a mother on her own may experience social isolation and higher levels of stress, which in turn negatively impact on her child's development. We thus control also for the mother's marital status at birth and whether the child has ever been in care by age 7.

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<sup>17</sup> These were based on the health visitors' observations, rather than direct questioning of the NCDS family.

#### iv) The neighbourhood

The social, demographic and economic profile of a region or local environment can exert a strong influence on the way a child grows and develops, as well as affect the pattern of availability and use of pre-school services.

Coarse measures of the local environment the child is growing in are the region within Britain and the type of administrative district. Additionally, we use information at the finer level of the Local Authority capturing the demographic or relevant age composition of the Local Authority (number of primary/secondary students per 1000 residents), the local income and employment structure (proportion of economically active females out of economically active males and share of males in semi- and unskilled occupations among economically active males), the weight given by the Local Authority to nursery as opposed to other levels of education (share of nursery pupils in total pupils and number of nursery pupils per teacher as a percentage of the total number of pupils per teacher). A number of indicators are finally used to capture the quality of primary and secondary education in the Local Authority: primary teachers' salary-cost per pupil, secondary teachers' salary-cost per pupil, all primary school costs per pupil and all secondary school costs per pupil. In addition to the quality of schooling, cost indicators in fact summarise several important features of the area, such as the pupil-teacher ratios or the age of school buildings.

To conclude, the set of observables we can control for is extensive; we feel that a case can indeed be made that we have data on the relevant child characteristics, family background influences, parental inputs and local characteristics upon which parents are likely to take their early education decisions.

Table 4.1: Summary of control variables

CHILD	
<p style="text-align: center;"><b>Characteristics</b></p> <p>Gender Ethnicity Mother's usual language with child is not English Birth weight Illness noted at birth Breastfed</p>	<p style="text-align: center;"><b>Early development</b></p> <p>Handicaps Attended welfare clinic under 1 year Not walking alone by 1.5 years Not speaking by 2 years Incontinent by day after 3 years</p>
PARENTS	
<p style="text-align: center;"><b>Pregnancy history</b></p> <p>Past miscarriages, neonatal deaths or complications Interval between marriage and 1<sup>st</sup> birth</p> <p style="text-align: center;"><b>Human capital</b></p> <p>Father's years of education Mother's years of education Mother reads newspaper most days &amp; books most wks Father reads newspaper most days &amp; books most wks</p> <p style="text-align: center;"><b>Socioeconomic status</b></p> <p>Maternal grandfather's social class Paternal grandfather's social class Social class of mother's husband</p>	<p style="text-align: center;"><b>Health/demographics</b></p> <p>Mother's age Father's age Mother's intensity of smoking prior to pregnancy Stopped smoking in pregnancy Mother is obese UK region where mother was born</p> <p style="text-align: center;"><b>Mother's labour supply at pregnancy</b></p> <p>Social class (type of paid job) Works over 40 hours in pregnancy Stops work after 29 weeks in pregnancy</p>
HOME / LEARNING ENVIRONMENT	
<p style="text-align: center;"><b>Family type</b></p> <p>Mother's marital status at birth: married, unmarried, or separated, divorced or widowed Child in care by age 7</p> <p style="text-align: center;"><b>Family difficulties</b></p> <p>Physical illness or disability Mental illness, neurosis or subnormality Divorce, separation, desertion; domestic/in-law tension Alcoholism Other serious difficulties</p>	<p style="text-align: center;"><b>Parental time</b></p> <p>Child has twin Birth order Any older brother Any older sister Has close sibling Family size</p>
LOCAL CHARACTERISTICS	
<p>Administrative County or County Borough Region</p> <p style="text-align: center;"><b>LA demographic composition ('65)</b></p> <p>Primary students/1000 population Secondary students/1000 population</p> <p style="text-align: center;"><b>LA local income / employment structure ('61)</b></p> <p>Active females as % of active males % males in semi- and unskilled occupations</p>	<p style="text-align: center;"><b>Relative weight given by LA to nursery ('58)</b></p> <p>Nursery pupils as % of total pupils Nursery pupils per teacher over all pupils per teacher</p> <p style="text-align: center;"><b>Quality of primary, secondary educat. in LA ('65)</b></p> <p>Primary teachers' salary-cost per pupil Secondary teachers' salary-cost per pupil All primary school costs per pupil All secondary school costs per pupil</p>

### 4.3 Subgroup analysis

As well as estimating the effects of early education, variously defined, on the population at large, we can further explore potential channels through which the early education effects might be operating by performing a variety of subgroup analyses: by gender, birth order, father's social class, parental education, home environment and mother's work status.<sup>18</sup> Table 5.2 summarises the subgroups we look at and the criteria we chose to define them.

Table 5.2: Subgroup analysis

Category	Subgroups	Criterion
Gender	Boy	
	Girl	
Birth order	High	First- or only-born
	Low	2 <sup>nd</sup> - or further-born
Social class	Low	Father's social class is III, IV or V
	High	Father's social class is I or II
Parental education	Low	Neither mother nor father stayed on
	High	Either or both parents stayed on
Home environment	Difficult	Any serious difficulties (*)
	Not difficult	No serious difficulties (*)
Mother's work status	No work	
	Part-time work	
	Full-time work	

(\*): Physical illness, disability; Mental illness, neurosis or sub-normality; Divorce, separation, desertion; Domestic tension; In-law conflicts; Alcoholism; Any other serious difficulties affecting child's development.

## 5. Results

### 5.1 Differences in performance and determinants of participation in early education

To obtain a general idea of the differences in outcomes between children attending early education and non-participants, we perform some simple exploratory analysis for selected outcome measures.

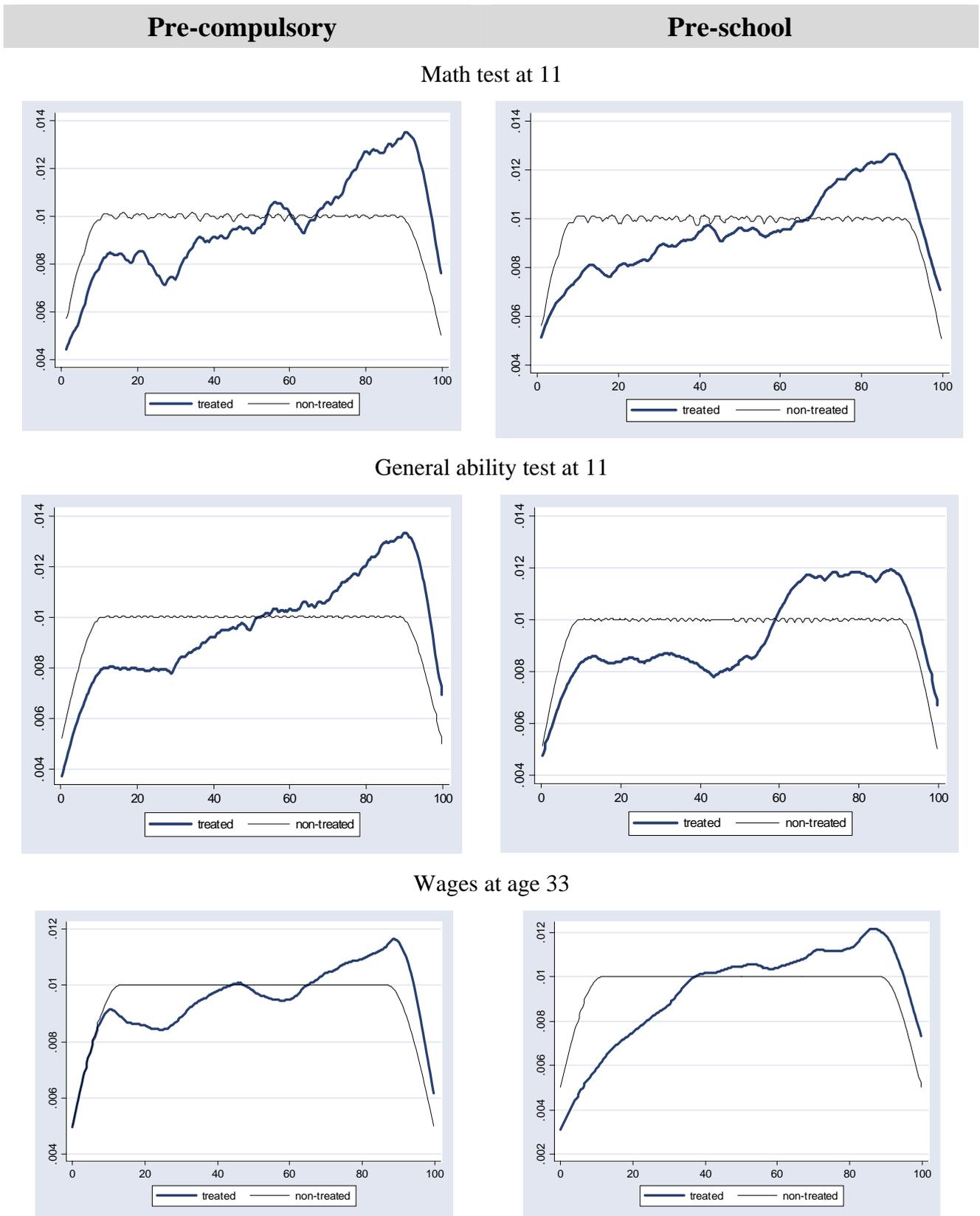
Since there are no natural units for test results, for this descriptive analysis we follow Krueger (1999) and scale test scores into percentile ranks. Specifically, the non-participant children are assigned percentile ranks based on their scores, from 0 (lowest) to 100 (highest). We then determine where in the distribution of the non-participant children every early educated child would fall and assign him or her the corresponding percentile score.

The upper two panels of Figure 5.1 show the distribution of percentile ranks in math and general ability tests at age 11 for participating and non-participating children, where participation refers either to pre-compulsory or to pre-school education. Since by construction the distribution for non-participating children is uniform, these plots reveal at a glance how differently the participating children perform. In particular, children with early education are visibly concentrated among the top ranks, which shows how much stronger on these tests these children are.

<sup>18</sup> In the conclusions we sketch other potentially interesting policy effects we could estimate; for some of them, subgroup analyses could further be performed in terms of the age when starting nursery and the quality of provision (the latter though restricted to the average quality of the maintained nurseries in the child's Local Authority of residence).

In fact, further on in these children's lives, those with some pre-school still clearly outperform those who were cared at home in childhood in terms of markedly higher wages at age 33.

Figure 5.1: Kernel density estimates of the distribution of percentile ranks for treated and non-treated children



As to the pattern of participation in early education for children born in 1958, Table 5.1 shows that as many as 60% of them had some form of schooling prior to the statutory school starting age of 5. For the large majority (three quarters) this early education was only in terms of an early start to infant school. A considerable number however attended a pre-school placement, with roughly an equal share (over 10%) being in the maintained and private sectors. In the latter, an almost equal proportion (5-6%) started their early education in a nursery as in the less formal setting of playgroups.

Table 5.1: Sample split by type of pre-compulsory education

	No.	%
No pre-compulsory education	4,343	39.7
Any pre-compulsory education	6,605	60.3
<i>of whom:</i>		<i>of whom:</i>
– Only entered school early	4,921	74.5
– LEA nursery (some also with early schooling)	831	12.6
– Private nursery (some also with early schooling)	371	5.6
– Playgroup (62% also with early schooling)	377	5.7
– Nursery and playgroup (some also with early schooling)	105	1.6

If we by contrast focus strictly on pre-school education (either private or LEA nursery, or playgroup) without taking into account whether the child subsequently went to school early, the picture changes markedly (Table 5.2). Around 15% of the children received pre-school education; this is considerably smaller than the 60% who received *any* early education, as most of these were early school entrants. In fact, although as many as 85% of the children had had no pre-school education at all, over half of them started infant school before age 5. The type of provision for pre-school attenders closely reflects the pattern above: an equal split between same maintained and independent institutions, and, within the latter, between nurseries and playgroups.

Although the overall incidence of pre-school education is considerably lower in our sample than amongst present day children, our sample size of 1,684 children receiving any, or some combination of pre-schooling, is comparable to the EPPE sample, with the added advantage that we are able to follow them up well into adulthood.

Table 5.2: Sample split by type of pre-school education

	No.	%
No pre-school education (53.1% of whom entered school early)	9,266	84.6
Any pre-school education	1,684	15.4
<i>of whom:</i>		<i>of whom:</i>
– LEA nursery (some also with early schooling)	831	49.3
– Private nursery (some also with early schooling)	371	22.0
– Playgroup (62% also with early schooling)	377	22.4
– Nursery and playgroup (some also with early schooling)	105	6.2

As to the determinants of early education investment, we find that the average personal, parental, home environment and regional characteristics of the children attending pre-school or receiving early education differed in important ways from those of children with no pre-school or early education experience.

On the one hand, we have found a higher incidence of some child characteristics that we might also think of as contributing to poorer educational outcomes among early education children (incontinence, disability, welfare clinic attendance, having a twin, not being spoken to in English). These

are however small differences; by contrast, large disparities working in the opposite direction were found in terms of family factors (mother's human capital and social class of the father, mother and even maternal grandfather). A child who is underprivileged for social or economic reasons (proxied by social class) was shown to be far *less* likely to have had any pre-school or pre-compulsory experience than a relatively more advantaged child. These disparities are likely to be further compounded by the large differences we found in the availability and experience of pre-school and pre-compulsory education depending on the social, demographic and economic profiles of the regions and LAs they lived in. In particular, living in urban areas, in Local Authorities with a lower-than-median share of unskilled male workers, a higher average social class (and presumably also income), or a higher share of working females were all found to translate into higher use of early education services.<sup>19</sup>

Since the most influential differences are thus those which have traditionally been associated with increased risk of problem behaviour and poorer cognitive development, the raw performance comparisons in Figure 5.1 are most likely to over-estimate the benefits of early education. The next two sections investigate how robust the apparent benefits from early education actually are.

## **5.2 The effects of pre-compulsory education**

We first consider the effects of any pre-compulsory education, defined as any formal education before the autumn that the child turns five. This treatment is made up of early school entry, nursery, and playgroup (or any combination of these); as shown in Table 5.1, this treatment group is largely made up of those who started school early, but did not have any prior nursery or playgroup experience. The comparison group is those who did not have any formal education before age 5.

### **Effects of pre-compulsory education on cognitive test scores at 7, 11 and 16**

Of particular interest is the effect of pre-compulsory education on cognitive development. The first column of Table 5.3 shows our OLS estimates of the effects of pre-compulsory education on a range of standardised test scores taken between age 7 and 16. The results confirm that pre-compulsory education leads to consistently better test scores, both on average, and separately in maths and reading, at age 7. Importantly, we also find that these gains persist, diminished in size, through to ages 11 and 16.

For example, our OLS results suggest that obtaining early education is associated with an increase of 9 per cent of a standard deviation in average test scores at age 7; by age 11, the gain is around 7 percent; by age 16 this has declined to just over half its size at age 7, but remains highly statistically significant at around 5 percent. The gains in terms of standard deviations of test scores are even bigger when we consider separate maths and reading tests. For example, our OLS results suggest an average gain in maths tests of 14 percent of a standard deviation by age 7, reduced to 12 percent by age 11, and again roughly halved from its original (age 7) level to around 7 percent by age 16. The gains to reading test scores are of a similar magnitude and follow a similar profile over time.

In Section 4.1 we discussed the use of other methodologies besides OLS for identifying the treatment effects of interest. The series of F-tests on heterogeneous effects based on the fully interacted linear model (FILM) suggest that there are no heterogeneous effects; in fact, such estimates basi-

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<sup>19</sup> Child and family characteristics were found to have a stronger impact on the utilisation of pre-school as opposed to pre-compulsory education services, while the latter was found to be more strongly associated with local characteristics and regional. Since the pre-compulsory treatment is largely driven by early school starters, this pattern is consistent with early entry into infant schools being largely determined by Local Education Authorities' school policies.

cally coincide with the ones from standard OLS. Furthermore, our matching analysis suggests that the two groups of interest can be safely regarded as highly comparable<sup>20</sup>, so that the restrictions of the simple OLS regression are in effect not binding. This is indeed confirmed by the matching estimates, which coincide with those from FILM and from OLS. For simplicity we thus present OLS estimates only.

How economically significant are these effects? One way of answering this is to compare the magnitude of the estimated treatment effects to the estimated coefficients on some other family and environmental factors we control for in our OLS specification. Although these other coefficients do not straightforwardly measure analogous ‘treatment’ effects (since the observable factors we control for are not chosen to identify the effects of other treatments besides the early education treatments of central interest to this paper), they give us some indication of how the effects of pre-compulsory education might compare to other important factors affecting children’s development. Table 5.3 shows that whilst the positive effects of pre-compulsory education on test scores are larger than the effect of having a father with a high social class at age 7, the advantage conferred by social class is magnified over time<sup>21</sup>, whilst the effects of pre-compulsory education diminishes. By age 11 and 16, the positive advantages of early education are considerably smaller in magnitude than the positive advantages associated with social class. Similarly, whilst the positive effect of pre-compulsory education is of approximately the same magnitude (but opposite direction) as the detrimental effects associated with living in a family with severe difficulties at age 7, the effects of the family difficulties persist basically unchanged over time, whilst the early schooling effects are greatly diminished. The other comparison we provide is with additional years of mother’s schooling. At age 7, pre-compulsory school attendance is worth the equivalent of between 3-5 years of extra maternal schooling. By age 16 the effect is reduced to the equivalent of around 1 to 2 years of maternal schooling.

Table 5.3: Effects of pre-school compulsory education on cognitive test scores, and coefficients on other aspects of the home environment (OLS estimates)

		Pre-compulsory education	Father’s social class I or II	Difficult home environment	Mother’s years of education
at 7	All <sup>a</sup>	0.090***	0.051*	-0.097***	0.025***
	Maths	0.141***	0.133***	-0.193***	0.046***
	Reading	0.163***	0.159***	-0.264***	0.034***
at 11	All <sup>a</sup>	0.067***	0.124***	-0.088***	0.034***
	Maths	0.118***	0.206***	-0.224***	0.054***
	Reading	0.083***	0.271***	-0.154***	0.060***
at 16	All <sup>a</sup>	0.048***	0.085**	-0.092***	0.030***
	Maths	0.069***	0.236***	-0.193***	0.065***
	Reading	0.070***	0.169***	-0.184***	0.042***

Notes: <sup>a</sup> average over all tests administered at that age. Note that more than maths and reading tests make up the average for ages 7 and 11. Also, at all ages, the average score is calculated based on any available test score; sample sizes might thus differ. \*\*\* significant at 1%, \*\* at 5%, \* at 10%.

<sup>20</sup> Our indicators of matching quality show that characteristics can be balanced extremely well between treated and non-treated children; furthermore, only 0.2% of treated children has to be discarded because of lack of overlap in the distribution of characteristics.

<sup>21</sup> This is consistent with other work showing how the test-score advantage of being from a high social class increases with age (see Feinstein, 2003).

## Effects of pre-compulsory education on measures of socialisation at 7, 11 and 16

The picture of how pre-compulsory education affects social skills is more mixed than the picture described above for cognitive skills. In general we find that early education leads to better *teacher-reported* social skills at age 7. Attending some kind of early education leads to a 5 percent of a standard deviation improvement in the BSAG behavioural disturbance score at age 7. However, some particular types of social skills appear to be negatively affected by early education at age 7. For example, early education leads to more parental reports of poor self-control at age 7 (such as irritability and difficulty concentrating); the effects appear to be neutral on parental reports of interpersonal skills, and the child's happiness or otherwise to attend school (the latter not shown).

The positive effects on teacher-reported social skills we found at age 7 do not appear to persist by age 11 or age 16, though the improvement does persist for some sub-groups of the population (as we discuss in the subsection below). Nor do there appear to be long-lasting effects for parent-reports of social skills. This contrasts with the markedly large, negative effects on social skills of a difficult home environment across all ages, and a few instances of marginally positive effects of high social class and additional years of mother's education.

Table 5.4: Effects of pre-school compulsory education on measures of socialisation, and coefficients on other aspects of the home environment (OLS estimates)

		Pre- compulsory education	Father's social class I or II	Difficult home envi- ronment	Mother's years of education
at 7	BSAG <sup>a</sup> (T)	-0.053***	-0.079	0.206***	-0.008
	Very bad interpersonal skills <sup>b</sup> (P)	0.002	-0.010*	0.028***	0.000
	Very bad self-control skills <sup>c</sup> (P)	0.008**	-0.001	0.032***	-0.001
at 11	BSAG <sup>a</sup> (T)	-0.018	-0.070	0.234***	-0.018*
	Very bad skills <sup>d</sup> (P)	0.002	-0.010*	0.028***	0.000
	Pre/Delinquent (T)	0.002	-0.013	0.018***	0.000
at 16	Police trouble / to court	0.005	0.008	0.063***	-0.002

Notes: (T): teacher's report; (P): parental report

<sup>a</sup> total standardised score of behavioural *maladjustment*.

<sup>b</sup> Proportion of very bad interpersonal skills out of: over-dependence on mother, meets other kids outside household; fights other children; bullied by other kids; disobedient.

<sup>c</sup> Proportion of very bad self-control skills out of: generally destructive, irritable, difficulty concentrating, upset by new situation, miserable or tearful, has temper tantrums.

<sup>d</sup> Proportion of very bad skills out of: difficulty settling to anything, destroys own/others' things, irritable, upset by new situation, fights with other children, bullied by other children, disobedient at home, miserable or tearful.

\*\*\* significant at 1%, \*\* at 5%, \* at 10%.

## Effects of pre-compulsory education on education and labour market outcomes

Pre-compulsory schooling is found to have positive effects on both early schooling outcomes – such as on the probability of having special education needs at age 7 – and on later educational outcomes such as the probability of obtaining qualifications at Level 2 or higher. However we cannot detect any impact of pre-compulsory schooling on the probability of obtaining higher education qualifications. We also detect some fairly weak evidence of positive labour market effects, with pre-

compulsory schooling exerting a marginally significant positive effect on the probability of being in employment at age 33 and on wages at age 33.<sup>22</sup> By age 42, however, any effect has disappeared.

Table 5.5: Effects of pre-school compulsory education on labour market and educational outcomes (OLS estimates)

Labour market			Education		
at 33	Employment	0.018*	at 7	Needs/Special education	-0.038***
	Wages	0.027*	at 33	Any qualification	0.029***
at 42	Employment	0.006		Higher education	0.007
	Wages	0.022			

Notes: \*\*\* significant at 1%, \*\* at 5%, \* at 10%.

### Sub-group effects of pre-compulsory education

As to gender differences, although the effect of pre-compulsory education on average cognitive test scores at age 7 is significantly larger for boys than girls (driven by a larger improvement in reading scores for boys compared to girls at this age), we do not find any evidence that these differences in effects persist beyond age 7.

Turning next to differences by social class: contrary to much research from the US on the effectiveness of early years' education (see Section 2), we find little evidence that children from more disadvantaged backgrounds (proxied by having a father ranked social class IV or V) gained any more, in absolute terms, from early education than those from high social class backgrounds (I or II). However we do find that early education reduced the probability that a child from a low social class background would need special education at age 7, whilst it did not have any effect for children from higher social class backgrounds. Further work will assess whether parental social class has an effect on relative outcomes: in other words if we take into account that children from low social class backgrounds tend to start from a lower base of test score results, we may see bigger relative improvements in their scores compared to children from high social class backgrounds as a result of early educational experiences.

We find considerable evidence that the benefits of pre-compulsory education accrue in more instances to 2<sup>nd</sup> born and other children, rather than to first borns (or only children). What negative effects there may be, for example on parental reports of social skills, appear often to affect first borns rather than 2<sup>nd</sup> borns. For example, we find that the improvement in reading scores at age 7, and the average, maths, and reading scores at age 11 and at age 16 are all significantly larger for later borns compared to 1<sup>st</sup> borns. Indeed, for all but test scores at age 7, we cannot find significant effects of early education for first-borns at all, whilst we always find positive and significant effects for 2<sup>nd</sup> and later born children in their test score results. By contrast, the effects of pre-compulsory education on parental reports of poor self-control skills at age 7 (see Table 5.4) are driven by the effects on 1<sup>st</sup> born children; for 2<sup>nd</sup> born and others, early education does not appear to have negative effects on self-control. At age 11, pre-compulsory education has a beneficial effect on teacher-reports of social adjustment for 2<sup>nd</sup> borns, but not for first borns (resulting in no significant effects across the population as a whole).

These differences between 1<sup>st</sup> borns and later borns in the effects of pre-compulsory education persist well into adulthood. We find positive effects of early education on wages both at 33 and at age 42 for 2<sup>nd</sup> and later born children, but no effects at all for first borns. These differences between 1<sup>st</sup>

<sup>22</sup> Wage effects need in general to be interpreted with caution due to potential differential selection into employment, especially given the presence of a small effect on employment probability.

and later borns are found to be statistically significant at the 5 per cent level.

It is interesting to speculate as to why the effects are better for later born children. It may be that first borns – of whom 22% are in fact only children – receive better quality attention at home in the very early years of their lives, whilst later borns have to share parental inputs with other siblings from the moment they are born. In this case, early education may play the role of *substituting* for parental care for later borns, compensating them for an early deficit in parental inputs compared to first borns. On the other hand it may be that later born children are able to gain more from early education because their older siblings spend time helping them and reinforcing what they learn at early schooling, for example practicing reading (in this case the home environment plays a more *complementary* role in early education for later born children).

### **Age the child starts school**

We have also considered whether there are any differences in the effects of pre-compulsory schooling depending on *what age* the child began nursery or early schooling.<sup>23</sup> Although as discussed above, starting school or pre-school before the age of 5 has generally beneficial effects on cognitive and some labour market outcomes, we could not find much evidence for differences in these effects according to the age when the child started this early schooling. In particular, no clear picture emerged as to an “optimal” age at which to start early schooling, nor did we find any particular gain or penalty from starting at age 3 or younger.

## **5.3 The effects of pre-school education**

The next effects we consider are those of any pre-school education, summarised in table 5.6. The treatment group is made up of all children who had any nursery or playgroup education before starting formal schooling. The control group consists of those who did not go to nursery or playgroup before starting school. Both treatment and control groups therefore contain children who started school early.

Attendance at an early education setting before entering school also leads to higher average test scores at age 7, driven in particular by a better performance in maths. Specifically, we find that at age 7, pre-school leads to a 5 percent of a standard deviation increase in average test scores (equivalent to the effects of an additional 2 years of maternal education) and to an 8 percent of a standard deviation increment in maths scores (OLS estimates).<sup>24</sup> This evidence of positive effects on early cognitive performance is consistent with the findings from the EPPE study, which considers the effects of pre-school education on cognitive tests up to age 7 for a cohort of today’s young children (see Section 2).

However, unlike EPPE, we use a much older cohort, and are thus able to look at whether these effects persist beyond age 7. In contrast to pre-compulsory education more generally (i.e. also including early attendance at infant school as part of the treatment *and* preventing the comparison children from starting infant school before 5), we find only weak, and somewhat mixed evidence of any long-lasting effects on cognitive scores, once controlling for detailed child characteristics and background influences.

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<sup>23</sup> Note we do not consider the age at which a child started playgroup in this analysis.

<sup>24</sup> As was the case in section 5.2, we do not find evidence of effect heterogeneity or incomparability between groups; the estimates from FILM, matching and OLS thus basically coincide. For simplicity, we report only the latter.

By age 11 we still detect a 4 percent of a standard deviation estimated increase in average tests and reading test scores, with these effects significant at the 5 percent and 10 percent level, respectively. However by age 16, there is only weak evidence of continued effects, with average and reading test results unaffected, and a 5 percent of a standard deviation increase in maths scores, which is significant only at the 10 percent level.

As to social skills, we do not find any evidence of an improvement in teacher-reported social skills for those attending pre-school. This contrasts with our results looking at pre-compulsory schooling more generally, where teachers reports were favourable at age 7 for the treatment group (Table 5.4). Parental reports of the incidence of poor skills, particularly those related to aspects of self-control of the child are however significantly higher at age 7 if the child attended pre-school. This apparently negative effect persists up to age 11, though at age 16 there no longer appear to be any significantly negative effects.

There do not seem to be any long-lasting effects of attending pre-school on education and labour market outcomes (though we do detect a marginally significant positive effect on wages at age 33). This is consistent with the lack of persistence of effects on cognition and other skills, which are known to contribute to academic achievement and labour market success.

It is perhaps not surprising that the estimated effects of attending pre-school are smaller than those outlined in section 5.2 looking at pre-compulsory schooling more generally; this is because members of both the treatment and the comparison group may start their main schooling before the age of 5, whereas in the previous section the comparison group contained only those who did not obtain *any* education before age 5. If entering formal education before age 5 is of any value, then the effects of pre-school education are likely to be smaller than when children whose only early education was starting school before age 5 are included in the treatment rather than the comparison group.

### **Sub-group effects of pre-compulsory education**

Unlike for pre-compulsory education more generally, we do not find differential effects for boys and girls of attending pre-school on test scores. However we do find some differential effects on social skills and longer-term labour market outcomes. In particular we find that pre-school attendance may be more damaging to boys rather than girls in terms of some measures of social skills: specifically, we find a higher probability of delinquent behaviour at age 11, and a larger number of poor social skills reported by teachers at 16 for boys rather than for girls as a result of attending pre-school. Indeed, although pre-school appears to have negative effects on these outcomes for boys, it does not have any detectable effects for girls. By contrast, attending pre-school appears to have positive longer-term benefits for girls that we do not find for boys. For example, we find a significant effect of pre-school attendance on the probability of a girl obtaining a degree or other HE qualifications as well as on wages at age 33 for those in employment<sup>25</sup>; we do not find a similar effect for boys.<sup>26</sup>

We also find some weak evidence that the benefits of pre-school education accrue in more instances to 2<sup>nd</sup> born and other children, rather than to first (or only) borns, and that what negative effects there may be on social skills, affect first/only borns more than 2<sup>nd</sup> borns. However this evidence is less strong than when we considered pre-compulsory education more generally. For example, we

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<sup>25</sup> Wage effects need in general to be interpreted with caution due to potential differential selection into employment, especially for women. This however would not appear to be a concern in our case, given the lack of any impact of pre-school on employment probability.

<sup>26</sup> The difference between these estimated effects on education and labour market outcomes for boys and girls are statistically significant.

find that there is an improvement in maths test scores at 16 for later borns attending pre-school, but not for first/only borns. Parental reports of poor self-control at 7 as a result of pre-school are found for first/only borns, but not for later borns.

Again we find little evidence of differential effectiveness of pre-school according to social class of the father. If anything, children from high social class background see greater benefits in terms of some test score results at some ages than children from low social class backgrounds. The EPPE study too did not uncover any consistent advantage from pre-school accruing to low-social class children as compared to their more advantaged peers; in fact, at age 7 the effects on reading and especially on maths were found to be *smaller* in magnitude for low-social class children, with only the gain in terms of writing being marginally larger for them (Sammons *et al.*, 2004, Fig.5.3). These results are strikingly similar to ours concerning children born some 40 years before.<sup>27</sup> In contrast to the EPPE study we can however follow children for much longer, and we find in fact that children from low social class backgrounds do see a greater increase in their probability of obtaining L2 or higher qualifications from obtaining pre-school compared to high social class children, who see no benefit on average in this regard. We do not see any differential effects on social skills. Again, future work will look at the picture if we consider relative rather than absolute gains or losses.<sup>28</sup>

It is interesting to note however that pre-school attendance appears to have some more positive effects on average for children in families with serious difficulties than for those without such difficulties, suggesting that in the early years, pre-school may play an important role in protecting such children from some of the potentially harmful effects of growing up in their family environment. For example, children from families with severe difficulties benefit significantly more in terms of maths and reading tests at age 7 than do other children. Such children also see positive effects in terms of the probability of gaining qualifications, and also on wages at age 42, whereas other children do not (and these differences are statistically significant). It is interesting that these differential effects are more pronounced when considering pre-school alone, rather than looking at the effects of pre-school and early schooling taken together (section 5.2).

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<sup>27</sup> Specifically, for maths we find a non-significant effect of 8 percent of a standard deviation for low-social class children compared to a significant 15 percent gain for high-social class children; for reading, the effects for both groups are small and insignificant (1 and 3%); while for copying design the gain is a significant 16 percent for the disadvantaged group and an insignificant 8 percent for the advanced one.

<sup>28</sup> In fact, the EPPE study notes that pre-school could be making the difference for low-social class children by allowing them to move above the expected minimum levels in Key Stage 1 attainment in reading and writing.

Table 5.6: Effects of pre-school education (OLS estimates)

<b>Cognitive test scores</b>			<b>Socialisation</b>		
at 7	All <sup>a</sup>	0.053 <sup>***</sup>	at 7	BSAG	0.024
	Math	0.083 <sup>***</sup>		Very bad interpersonal skills	0.003
	Reading	0.028		Very bad self-control skills	0.014 <sup>***</sup>
at 11	All <sup>a</sup>	0.036 <sup>**</sup>	at 11	BSAG	0.040
	Math	0.024		Very bad skills	0.010 <sup>***</sup>
	Reading	0.044 <sup>*</sup>		Pre/Delinquent	0.008
at 16	All <sup>a</sup>	0.005	at 16	Police trouble / to court	0.013
	Math	0.051 <sup>*</sup>			
	Reading	-0.007			
<b>Labour market</b>			<b>Education</b>		
at 33	Employment	0.018	at 7	Needs/Special education	-0.001
	Wages	0.036 <sup>*</sup>	at 33	Any qualification	0.007
at 42	Employment	0.003		Higher education	0.015
	Wages	0.027			

Notes: see notes to tables 5.4 and 5.5. \*\*\* significant at 1%, \*\* at 5%, \* at 10%.

## 6. Conclusions

Our research has found that investments in human capital before the age of 5 appear to have had long-lasting and positive effects on the children from the 1958 cohort. We find that early education leads to improvements in cognitive tests, including both maths and reading at age 7; these effects diminish in size but remain significant throughout the schooling years, up to age 16. The effects on socialisation appear to be more mixed: we find some evidence of improvement in teacher reports, but a deterioration in parental reports of social skills at age 7, especially for first born children; however such effects on social skills (both positive and negative) do not tend to last, and are no longer detectable by age 11. We have also presented evidence that there are gains from early education in adulthood, both on educational attainment and labour market performance, through a higher probability of obtaining qualifications, and in turn marginally higher employment probabilities and wages at age 33.

How big are these estimated effects? As we have shown, the gains to early cognition (age 7) are of a comparable size to those associated with growing up in a family where the father is of high social class, and almost completely counteract the negative effects on test scores of growing up in a difficult family environment. However, whilst these latter family background effects either stay the same or grow bigger throughout childhood and adulthood, the effects of early education diminish, and so are small relative to the impact of these family background factors by the time the individual enters adulthood. The additions to wages due to extra schooling before the age of 5 (around 3 per cent, see Table 6.3) are small compared to the estimated gains from an extra year of schooling later on in a person's school career, which have been estimated at around 6 per cent (see e.g. Blundell *et al.*, 2005). On the other hand, for some groups of the population such as those who are not first-born children, the estimated effect on wages is somewhat higher (5 per cent for 2<sup>nd</sup> or later born children, at age 33 and 42).

Our research has also shown that there is a positive impact on early test scores of attending nursery before a young person attends primary school. However we find that these effects do not tend to be

long-lasting, with very weak evidence of continued effects through to age 16. Similarly, we find evidence of adverse behavioural effects from parental reports at age 7, persisting to age 11, but no longer detectable by age 16. Nonetheless, we do find evidence of marginally significant effects on wages at age 33 (around 4 percent) which are of a similar magnitude to the wage effects we found associated with pre-compulsory schooling more generally.

Although our results pertain to the pre-school experiences of children born in 1958, our findings are broadly in line with those for the 1970 birth cohort (Osborn and Milbank, 1987), as well as those for the more recent EPPE study. Although we cannot determine how representative of current provision the pre-school experience of the NCDS children was, as Osborn and Milbank (1987) also surmise, if anything the presumption is that any intervening changes in the practice, curriculum and organisation of pre-school institutions would have worked towards increasing the quality of the educational experience provided; thus the long-term benefits uncovered for the 1958 cohort are plausibly going to be even larger for current pre-school children.

In future work we intend to assess the robustness of our results to the presence of selection on unobservables by implementing an instrumental variable approach; historical conditions at the time the 1958 cohort were in their pre-school years allow us to exploit some arguably exogenous variation in local availability of maintained places. We further plan to explore additional outcomes – in particular parenting outcomes in terms of their own children’s cognitive and behavioural development – as well as to disaggregate the early education treatment in its main components, both to look at some specific ‘treatment’ in more detail and to assess the differential impact of one type of ‘treatment’ against another.

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