

# Childcare and early child development. Evaluating the impact of universal part-time preschool education in England

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## Abstract

Using a large administrative data set on all state schools in England, this paper studies the effect of free part-time preschool education at age 3 on child outcomes in primary school at ages 5 and 7. We use the staggered implementation of free preschool places across Local Education Authorities in England to identify 1) the effect of funding childcare places for 3-year-olds in nurseries and other registered settings on child outcomes, the effect of interest to policy makers; 2) the effect of attending preschool at age 3 on child outcomes. To control for selection into preschool, we instrument actual preschool attendance with the availability of free places. We find that a 10pp increase in the proportion of 3-year-olds covered by free places improves cognitive and non-cognitive outcomes at age 5 by 2-4% of a standard deviation, with larger effects for boys than girls and for children from higher than lower socio-economic backgrounds. By age 7 the positive effects have largely faded out. IV estimates indicate that a 10pp increase in the proportion of children attending preschool at age 3 improves age 5 outcomes by 5-12% of a standard deviation. Effects are larger for boys than girls and mostly fade out by age 7.

**Keywords:** childcare, child outcomes, instrumental variables

**JEL codes:** I22, I24, C21

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# 1 Introduction

High-quality formal childcare is thought to improve outcomes for children, and, if it targets children from deprived backgrounds, to reduce inequalities in society. Recent research in the economics of human capital production has emphasised the importance of timely investments into child development, as differences in children’s cognitive and non-cognitive development emerge at early ages and early investments have multiplier effects into the future (Almond and Currie, 2011; Carneiro and Heckman, 2004; Cunha and Heckman, 2004). Preschool education is one area where early investments can take place outside the family, so it may be particularly important for children whose parents invest little in them. Childcare is potentially also a powerful instrument for promoting maternal employment (Brewer and Crawford, 2010; Fitzpatrick, 2010; Berlinski et al., 2011) which not only provides the foundation for broad and resilient tax bases, but also helps in advancing gender equality.

Most OECD countries, including the UK, provide significant financial support for childcare in the form of cash subsidies and/or tax breaks, which reduce the cost of childcare, or an expansion in the supply of places through direct provision or subsidies directed to private providers. In the last few decades many countries have introduced publicly funded, universal preschool programmes which are thought to serve the twofold aim of improving child development and promoting maternal employment. However, the growing body of literature evaluating these universal programs has produced a wide range of estimates of the impact of free childcare on childrens cognitive and non-cognitive outcomes in the short and long term, and the evidence on the effectiveness of such programs is mixed (see for example Baker et al. 2008, Fitzpatrick, 2008; Dumas and Lefranc, 2010; Andrews et al. 2012; Black et al. 2012; Havnes and Mogstad, 2012; Felfe and Lalive, 2012; Felfe et al., 2012; Dustmann et al., 2013).

In England, all three and four year-olds became entitled from 2004 to a free part-time nursery place for (initially) 12.5 hours per week, 33 weeks per year, and similar policies were implemented in Scotland and Wales. From lagging well behind most European countries in the early 1990s, the UK is now one of the highest spenders on pre-primary services in Europe (OECD 2008). From 2013, the free childcare entitlement in England has been extended to

disadvantaged two year-olds. Despite the considerable funds invested into preschool education in England and the policy interest accompanying this, little is known about its effects. Research from the UK has established that high-quality formal childcare can improve outcomes for children (Sylva et al. 2004). However, the performance of English children at the start of school shows no improvement in cognitive development since the early 2000s - when the provision for 4 year olds was already universal, while the provision for 3 year olds was still being rolled out - and no closing of the gap between children from different social backgrounds (Merrell and Tymms 2011).

This is the first paper evaluating the causal effect of free preschool education for 3-year-olds on child outcomes in England.<sup>1</sup> We exploit the fact that the entitlement for 3 year olds was phased in differentially across Local Education Authorities (LEAs), with the proportion of 3 year-olds holding a free part-time nursery place varying substantially between LEAs and rising from 36% to 87%, on average, between 1999 and 2007. This implies that we can use both temporal and geographic variation to identify the effects of interest. We use a large administrative data set covering all students in state schools in England (92% of students) in which we can observe outcomes at age 5, at the end of reception year, and at age 7 (year 2), which marks the last year of infant schooling. This dataset has the advantage that i) it covers the universe of children in state schools, allowing us to detect even small effects precisely, ii) it is free of attrition, iii) we observe outcomes evaluated by teachers rather than arguably more subjective parental assessments, iv) we have measures at two early ages, 5 and 7, which allows us to analyse whether any early positive effects persist, v) we have a number of background characteristics that allow us to study heterogeneity of the effects by gender, family income (as measured by free school meal eligibility of the student)<sup>2</sup> and neighbourhood deprivation. In our data set we cannot, however, observe individual childcare participation, but as our measure of free part-time preschool availability varies at the LEA level, we carry out LEA-level analysis and measure childcare participation at the LEA level as the proportion of children aged 3 attending preschool.

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<sup>1</sup>There is a companion paper evaluating the causal effect of free preschool education for 3-year-olds on child outcomes using date-of-birth discontinuities in entitlement, see Balnden et al. 2014

<sup>2</sup>Free school meal eligibility is linked to parents' receipt of means-tested benefits such as income support and income-based job seeker's allowance and has been used in many studies as a low-income marker (see Hobbs and Vignoles 2007 for some shortcomings).

In this paper we are interested in estimating two effects. The first is the effect of availability of free childcare places for 3-year-olds in nurseries and other registered settings on child outcomes. This is the effect of interest to policy makers, and it will be a weighted average of a number of reactions to the implementation of the policy, including taking up pre-school instead of home care, substituting existing childcare arrangements for childcare at subsidised private providers, and increasing the hours at a private provider. The effect is estimated using reduced form models of free childcare availability on child outcomes with LEA fixed effects. Under the assumption that availability of free places is orthogonal to individual child characteristics we can give this estimate a causal interpretation. The second effect of interest is that of attending preschool at age 3 on child outcomes. To estimate this, we need to take account of the fact that selection into early education may be non-random. To control for selection into preschool, we instrument actual preschool attendance with the availability of free places, both measured at the LEA level, and again estimating models with LEA fixed effects.

Our reduced-form estimates indicate that a 10pp increase in the proportion of 3-year-olds covered by free places improves cognitive and non-cognitive outcomes at age 5 by 2-4% of a standard deviation, with larger effects for boys than girls and for children from higher than lower socio-economic backgrounds. The free entitlement increased the coverage with free places by about 50pp between 1999 and 2007, so the total effect of the policy may have been (up to) five times this effect<sup>3</sup>. By age 7 the positive effects have largely faded out. Small effects persist for higher ability boys and higher ability affluent children. We estimate that among four 3-year-olds for whom free places were made available, roughly one takes up a new childcare place while three substitute existing childcare arrangements. IV estimates instrumenting childcare attendance with availability of free places indicate that a 10pp increase in the proportion of children attending preschool at age 3 improves age 5 outcomes by 5-12% of a standard deviation. Effects are larger for boys than girls and largely fade out by age 7. At age 7 we find that the proportion of children classed as highly able in Reading and Writing increased by 4.2% and 6% with respect to the mean (0.26 and 0.13). In summary, the benefits of a universal entitlement to free preschool education for 3-year-olds in England were moderate and fairly shortlived and have not contributed to narrowing attainment gaps between children from different socio-economic backgrounds.

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<sup>3</sup>In our sample we observe years 2002 to 2007 only

The paper proceeds as follows. In the following section we outline the institutional background of the paper, explaining the policy and providing descriptive evidence of its roll-out. Section 3 describes the empirical strategy and Section 4 the data we use. Section 5 contains the results of the reduced form and IV estimates, and Section 6 concludes.

## 2 Institutional background

Historically the UK government had little intervention in the childcare market, believing that children of preschool age were best cared for by their mothers. Local Education Authorities were given the choice over whether they provide maintained nursery education (in nursery schools or within nursery classes in primary schools) and the number of nursery education places expanded from 1955 to 1973 (Green 2002) primarily in Labour controlled inner-city areas. During these decades the provision of free nursery places varied widely across Local Educational Authorities (LEAs), and was mainly targeted at children from the most deprived families (DES 1990). Funding was low compared with mainland Europe (Pugh 1996). By the year 2000, 36% of 3-year-olds had a place in the 'maintained' sector, with large variation between Local Education Authorities (LEAs).

In the 1970s the grassroots playgroup movement took off (usually providing two and a half hour sessions) and in the late 80s playgroups reached 13% of under 4s. Under the Conservatives there was a slight shift to supporting mothers in work, tax relief for employer-provided childcare and some support for childcare expenses through Family Credit. Private nursery provision grew in the so-called Private, Voluntary and Independent (PVI) sector. This sector includes formal, registered childcare in nurseries, at childminders and in playgroups. The most significant policy initiative of the Conservative government to stimulate the market for nursery provision was a voucher scheme for nursery school education introduced in 1997 at £1100 a year for all 4-year-olds.

Under Labour, 1998 saw the introduction of universal free part-time preschool for 4-year-olds under the Nursery Education Grant, which was achieved by 2000. The offer was for 12.5 hours per week of childcare, during 33 weeks in the year, in 2.5 hour daily sessions. A commitment to expanding the free entitlement to three year olds was to be achieved by 2004. In the roll-out of the entitlement for 3-year-olds the Department for Education

provided funds for childcare places initially in 65 Local Education Authorities in 1999-2000 and across the country from 2000-2001.

At the time of the introduction of free nursery places for 3-year-olds, the policy of interest in this paper, children of this age-group could already be receiving free preschool education in the maintained sector or attending privately paid for childcare in the PVI sector. Figure 1 gives an overview of the development of preschool education of children aged 3 between 1999, the year before universal part-time education was introduced in England, and 2007. The Figure shows that free places in the maintained sector remained relatively stable over the time-period with a small increase from 36.2% in 1999 to 38.3% in 2007. The variation in the percentage of free places available to 3-year-olds comes from places created in the PVI sector. From a 0% coverage in 1999, free PVI places increased rapidly until in 2007 49% of children aged 3 were receiving free childcare in the PVI sector. Figure 1 also shows the percentage of 3-year-olds receiving free childcare, which is the sum of free childcare in the maintained and PVI sectors. This percentage increased from 36.2% to 87.3% between 1999 and 2007. As the percentage of children in any type of childcare (publicly or privately funded) shows, the increase in free places was not fully translated into newly created places: whereas availability of free places increased by 45.4 percentage points between 2000 and 2007, the total proportion of children in childcare increased by just 13.4 percentage points.<sup>4</sup> This indicates that a considerable proportion of PVI sector childcare was substituted for free PVI places. These were usually the same places as before, with the only difference that funding was now from public rather than private funds.

All childcare providers in England are required to follow a common curriculum. Since 2008 this is the Early Years Foundation Stage, and prior to this, the (very similar) Curriculum Guidance to the Foundation Stage. The curriculum emphasises learning through play, ensuring that a range of stimulating activities are provided and that children's development across a range of areas is encouraged. Childcare workers are required to plan learning activities and to observe and document children's progress. Moreover, all settings are subject to inspection by the Government regulator OFSTED (Office for Standards in Education).

The type of early education experience that registered settings have to offer will vary, however, depending on where children take up their place. Funding rates in the maintained

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<sup>4</sup>Data on all places is not available for 1999.

sector are higher than for PVI providers (NAO 2012). Moreover, providers from different sectors have to comply with differing child to staff ratios and requirements regarding minimum qualification of staff. Nursery schools and classes in the maintained sector require that a qualified teacher is present, and have an adult-child ratio of 1:13 to reflect that well qualified staff are employed. In the private and voluntary sectors, on the other hand, requirements for qualifications are lower, but if there is no qualified teacher present then the ratio of adult per child is increased to 1:8 (Gambaro et al., 2013).

In terms of the duration of a preschool day, there is also a lot of variation between childcare settings. Maintained provision will usually be relatively restrictive in terms of hours available, often either five mornings or five afternoons, and usually will not extend outside school hours. In the PVI sector, private and independent day nurseries often focus on full-time care, so that the entitlement to free places acts only as a discount on fees, with few part-time places available. Voluntary pre-schools on the other hand, which evolved from community play-groups, generally offer care over more restricted hours.

As the identification strategy used in this paper relies on variation over time and across space in the availability of free childcare and in attending childcare, we show in Figures 2 and 3 how preschool education developed between 2000 and 2007 across LEAs. In the top two maps of Figure 2 we compare the proportion of 3-year-olds covered by free childcare places in 2000 and 2007. We can see that there was a substantial increase in free places in this time-period, and this was not uniformly distributed across LEAs: While the North of England and areas around London as well as Cornwall already had a fairly high coverage in 2000, the increase for most Southern areas of England was from a low level of coverage, in the 0-20% bracket. The bottom two maps of Figure 2 show the take-up of nursery places for 3-year-olds, both free and privately funded, in 2000 and 2007. The take-up was already high in 2000, but not uniformly distributed across the LEAs in England. Therefore the increase in places taken also differed between LEAs until nearly full take-up was achieved in 2007.

Figure 3 compares the types of free provision available to 3-year-olds in 2000 and 2007. The top two maps of Figure 3 show the proportion of 3-year-olds covered by the maintained sector. We can see that the distribution across the LEAs of England remained fairly constant across the time-period 2000-2007. The growth of free places came from free places becoming available in the PVI sector as a results of the universal entitlement. From a very low coverage

in 2000, the year after the policy was introduced, coverage with free PVI places increased substantially by 2000. The growth of places was concentrated in the Center and South of England where a lower proportion of 3-year-olds had access to places in the maintained sector.

### 3 Empirical strategy

In this paper we are interested in estimating two different effects. The first is the effect of making available free pre-school education places for 3-year-olds on child development. The second is the effect of 3-year-olds attending pre-school education on early child outcomes. To estimate the first we consider the following reduced form model:

$$Y_{icl} = \beta_1 F_{cl} + \beta_2 X_{icl} + \beta_3 Z_{cl} + \mu_l + e_{icl}, \quad (1)$$

where:

1.  $Y_{icl}$  is the child outcome of interest for child  $i$  in cohort  $c$  and Local Education Authority (LEA)  $l$  measured at ages 5 and 7 respectively.
2.  $F_{cl}$  is an indicator of the availability of free places in a LEA of residence for a given cohort of children. More precisely, it is the proportion of 3-year-olds for whom a free place is available, which is the number of free places for 3-year-olds divided by the population of the same age-group.
3.  $X_{icl}$  is a vector of child characteristics measured at age 7 including whether the child is eligible for free school meals<sup>5</sup>, white British ethnicity and the month of birth to control for relative age at test effects. We also include academic year controls
4.  $Z_{cl}$  is a vector of LEA-level characteristics that may affect child outcomes and are time-variant. We include controls for education levels, hourly and weekly pay and lagged employment rates of the male and female working age population.<sup>6</sup>

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<sup>5</sup>Free school meal (fsm) eligibility is at age 7 is a good proxy for low income at age 3. Research shows that children with fsm observed in any year will be affected by low income over longer periods of time (reference).

<sup>6</sup>We use lagged employment rates to account for the fact that the offer of free childcare may affect current employment rates.



5.  $\mu_l$  is a LEA fixed effect that controls for time-invariant LEA characteristics. In particular, it controls for the fact that the build-up of the program was systematically related to pre-treatment levels of free childcare and therefore, indirectly, to relative deprivation at the LEA level.<sup>7</sup>
6.  $e_{icl}$  is an idiosyncratic error term.

Our measure of availability of funded places for 3-year-olds varies at the LEA level, therefore we perform our empirical analysis on collapsed data at the LEA level, and we use as weights the number of individuals contributing to the means. The estimation equation therefore becomes:

$$Y_{cl} = \beta_1 F_{cl} + \beta_2 X_{cl} + \beta_3 Y_{cl} + \mu_l + e_{cl}, \quad (2)$$

This equation estimates the Intention To Treat (ITT) parameter,  $\beta_1$ , of the availability of funded places in an area at a particular point in time. As we are assuming that the funded places were exogenously assigned with respect to any child characteristics, we can give a causal interpretation to the ITT effect. The ITT effect measures the effect of the availability of funded places on child outcomes but a number of children have in fact not participated in pre-school education, i.e. declined the offer of treatment, so the ITT estimate is a lower bound of the average causal effect on those who participated in pre-school education. It is however the parameter that is of most interest from a policy point of view.

Our estimated ITT effects need to be considered in the context of the counterfactual activities children might engage in in absence of free childcare. Before the introduction of universal free part-time education for 3-year-olds this agegroup could have been in three alternative states, (i) the child is at home with parents/carers, (ii) the child receives pre-school education at the alternative free option in maintained nurseries and nursery classes in primary schools, (iii) the child participates in privately paid for childcare (PVI sector) which includes a variety of care options such as private nurseries, childminders and play groups, for example. Therefore the implicit treatment effect is going from home care to early

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<sup>7</sup>While it is quite plausible to assume that the proportion of 3-year-olds covered by free pre-school places is exogenous to the characteristics of an individual child  $i$ , we have to allow for the possibility that assignment of free places to LEAs was not random. In fact, evidence from the Department for Education indicates that funding was initially assigned to LEAs that were urban, and subsequently places increased more in those LEAs that had previously provided a lower than average coverage in the 'maintained' sector, i.e. in more affluent LEAs.

education; substituting private pre-school for funded early education; increasing the hours in the PVI pre-school setting; or substituting a 'maintained' place for a PVI place. The effects estimated using equation (2) are weighted averages of the implicit treatment effects, with weights given by the number of children that belong to each of the four possible reactions to the introduction of universal childcare. Depending on the quality of the alternative options, we can expect to find positive effects if the alternative options are of lesser, and negative effects if they are of higher quality.

To estimate the effect of attending pre-school education on child outcomes, our second effect of interest, we consider the following model, again using information collapsed at the LEA level:

$$Y_{icl} = \beta_1 PS_{cl} + \beta_2 X_{cl} + \beta_3 Y_{cl} + \mu_l + e_{cl}, \quad (3)$$

where we use the same variables as in the equation (2) above and  $PS_{cl}$  is the LEA-level proportion of 3-year-olds attending pre-school. In this model we have to consider that participation in pre-school education is potentially endogenous, as parents choosing to enrol their children are likely to have unobserved characteristics - such as preferences for investments into their children, for example - that are correlated with the outcomes we consider. In other words,  $Cov[X_{cl}, e_{icl}] \neq 0$ . While we would generally expect positive selection into childcare (see e.g. Dustmann et al. 2013), this is not necessarily the case in our application, because we are exploiting increases in childcare use among a population of 3-year-olds whose parents were not previously sending them to nursery. Therefore it is quite possible that we have negative selection into childcare and our estimates of equation 3 may be downward biased. To obtain estimates that we can interpret as causal, we instrument actual pre-school attendance  $PS_{cl}$  with the availability of funded places  $F_{cl}$ . So our IV estimates exploit variation over time and across LEAs in availability of free places and are independent of the endogenous selection into childcare.

In section 2 we have given an overview of childcare use. Given that children from deprived backgrounds were specifically targeted to benefit from 'maintained' nursery places and there is no reason to believe they would have substituted a 'maintained' for a PVI place<sup>8</sup>, we can expect the net effects to be driven by children not previously in free childcare. Therefore,

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<sup>8</sup>Maintained nursery places are reputedly of good quality and often offer a high number of hours.

they need to be interpreted as local average treatment effects, and we will provide more background on compliers in section x.

## 4 Data

The empirical analysis is based on the National Pupil Database (NPD), which is available from the English Department for Education and has been widely used for education research. The NPD is a longitudinal register dataset for all children in state school in England, covering roughly 92% of pupils. It combines pupil level attainment data with pupil characteristics as they progress through primary and secondary school.

### *Outcomes and observed background*

We study the effect of early education on children at ages 5 and 7. Primary school in England begins with the reception year, which children generally begin at age 4 in the academic year they turn 5. From birth to the end of reception year, at age 5, the so-called Early Years Foundation Stage sets standards for the learning, development and care of children in schools and pre-school settings in England. At the end of reception year children are assessed by their teacher according to the Foundation Stage Profile. This measures achievements of children aged five against 13 assessment scales with 9 points within each scale. The 13 assessment scales are grouped into six areas of learning which include personal, social and emotional development; communication, language and literacy; problem solving, reasoning and numeracy; knowledge and understanding of the world; physical development and creative development. We use as age 5 outcome standardised points scores in each of these areas as well as of the sum of the points in all assessment scales (Foundation Stage Profile total), all standardised separately by academic year,.

School education from age 5-16 is compulsory and learning during these years is divided into four Key Stages. Pupils are assessed against the National Curriculum at the end of year 2 (at age 7), which marks the end of the first Key Stage. Pupils are assessed in English, Mathematics and Science, where English has sub-assessments for Reading, Writing, and Speaking and Listening. In line with previous papers we focus on the outcomes in Reading, Writing and Mathematics, as these have been shown to be best predictors of long-term outcomes (reference). Grading is by levels, with possible outcomes ranging from "W"

(working towards) and levels 1 to 3, rarely higher. The expected level of attainment at age 7 is level 2, and children working at levels 3 or higher are generally considered by schools to be highly able in that subject. We therefore use the LEA-level proportion of students with level 2 or higher (expected level) and the proportion of pupils with level 3 or higher (highly able) in Reading, Writing and Mathematics as outcomes.

In the NPD we can observe some basic individual background variables, including gender, eligibility for Free School Meals, ethnicity, whether the first language spoken at home is English, whether the child has been defined by the school as having special educational needs, and information on the Income Deprivation Affecting Children (IDACI) score of the neighbourhood of residence. We do not use special educational needs status as control variable as it is arguable whether this is an outcome. We control in our regressions for the LEA-level proportions of children eligible for Free School Meals, White British ethnicity and birth month to account for relative age at test. In heterogeneity analysis we disaggregate our results according to neighbourhood deprivation of the neighbourhood of residence as measured by the IDACI score.

#### *LEA-level controls*

In our regressions we estimate LEA fixed effects to account for time-invariant LEA characteristics. We also want to make sure there are no time-varying factors at the LEA level that are associated with the build-up of free pre-school education. These controls capture economic conditions, including information from the Labour Force Survey on the proportion of working-age individuals with qualifications at the NVQ4 level or higher and the lagged employment rate of working-age individuals overall and of working-age women. We lag the employment rates to account for the fact that childcare availability might affect current employment rates. We also include the hourly and weekly mean pay from the NOMIS workplace analysis as controls.

Moreover, over the time-period 2002-2007 we need to consider that funds were allocated to a number of initiatives aimed at improving child care quality and offering services that improve child outcomes. One example are Sure Start Centres which provide help and advice on child and family health, parenting, money, training and employment. Such initiatives could be a cause for concern if their allocation was associated with the build-up of free preschool places for 3-year-olds. This would bias the estimates of models (2) and (3). To

rule out this possibility in future work we will include in our regressions indicator variables that capture whether a neighbourhood education grant or Sure Start Centre was available in a LEA in a given year.

### *Measures of childcare availability and take-up*

Headcounts of children aged 3 receiving free childcare by LEA are available from the Department for Education, with separate counts of children in the maintained sector (nurseries and nursery classes in primary schools) and in the PVI sector (private, voluntary and independent providers). The data is available from 1999, the year before the free provision for 3-year-olds was gradually introduced.

Headcounts of children taking up places in the PVI sector, including both free and privately funded places, are available for years 2000 to 2007. During data collection, in some years not all providers returned data to the Department for Education (DfE), so that DfE revised the figures by assigning the average number of children of the providers that did return data to the missing providers. This occurred in the years 2003-2007, with an estimated 3-4% of children missing in 2004, 2005 and 2006, and 14% (8%) missing in 2003 (2005). The data broken down by LEA was not revised by DfE, and we therefore adjust the data for 2003 and 2005 by interpolation and the data for 2003-2007 by increasing the counts in each LEA proportionally to the rate of unreported children in that year.<sup>9</sup>

Our measure of free part-time pre-school places is the sum of places in the maintained sector and free places in the PVI sector, divided by the population of 3-year-olds in each LEA.<sup>10</sup> Our measure of childcare take-up is the sum of places in the maintained sector and all places taken up in the PVI sector, divided by the population of 3-year-olds. We scale these measures so that a unit change represents a 10 percentage point increase in the children covered by free nursery places and taking up nursery places, respectively. We merge this data to children observed in the National Pupil Database using their LEA of residence at age 7. All children that were aged three in the month a headcount was taken are assigned

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<sup>9</sup>More precisely, we first apply linear interpolation between the preceding and following year for years 2003 and 2005 and replace the data for a LEA if the interpolation leads to a higher count than the recorded count. This reduces the proportion of missing children to 5.4% in 2003 and 3.8% in 2005. We then increase the counts in each LEA by the proportion of children deemed by DfE to be missing in the returns overall, so that the count of children across all LEAs coincides with figures published by DfE.

<sup>10</sup>The population figures are population estimates from the Office of National Statistics.

the corresponding measure. Children turning 3 after that month are assigned the following year’s measurement.

### *Estimation sample*

Measures of the take-up of childcare are available for years 2000-2007, and we can observe age 7 outcomes for all the cohorts that were aged 3 in this time-period. The Foundation Stage Profile at age 5 was first recorded for children that were aged 3 in 2001/2002.<sup>11</sup> Because we are interested in comparing the effect of availability of free childcare and of attending childcare on child outcomes at different ages, our main estimation sample includes the years for which we have outcomes for both ages. These are six cohorts of children aged 3 in the years 2001-2007 with observations at age 5 relating to academic years 2002/03 to 2007/08 and observations at age 7 relating to academic years 2004/05 to 2009/10. For outcomes at age 7 we will also perform estimations on the sample spanning the whole time-period for which we have childcare take-up data, academic years 2002/03 to 2009/10.

From this sample we remove children living in Scotland or Wales and attending school in England, children in “special schools” that exclusively cater for children with specific needs, for example because of physical disabilities or severe learning difficulties. Moreover, we exclude a small number of children that are younger or older than the children expected to belong to a particular school cohort.<sup>12</sup> Finally, we retain only pupils for whom we have non-missing outcomes and background characteristics. The main estimation sample includes 6 cohorts of children with 3.2 million observations. When collapsing the individual-level data to LEA level we have a minimum of 323 and a maximum of 15,681 students contributing to LEA level means. These numbers are lower when we collapse by gender (150 to 8,001) and by free school meal status (12 to 13,639). Five LEAs have fewer than 100 students in some years when collapsing data by free school status, and we perform sensitivity analysis excluding these LEAs.

Table 1 shows descriptive statistics for child outcomes at ages 5 and 7. We display mean raw Foundation Stage Profile point scores and the proportion of students reaching the expected level and being classed as highly able at age 7, separately for the whole sample, as well as by gender and free school meal status. The Table shows that girls are outperforming

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<sup>11</sup>In the first 4 years FSP data was collected for a 10% sample of school children.

<sup>12</sup>Note that there is no grade repetition in the UK.

boys in all outcome measures at both ages, with the exception of being highly able in Mathematics, which is achieved by a higher proportion of boys than girls. Even larger differences can be found between children eligible for free school meals and other children. At age 5 the mean Foundation Stage Profile score of children on free school meals is 11% lower than that for children who are not eligible. At age 7 the proportion of children from low-income families attaining expected levels in reading, writing and maths is 12 to 19 percentage points lower than the proportion attaining expected levels from higher income families. The proportion of students being classed as highly able is more than twice as high among children from higher income families.

## 5 Results

### 5.1 Reduced form estimates

Our first set of results examine the effect of availability of free part-time preschool for 3-year-olds on child outcomes at ages 5 and 7. These reduced form estimates are relevant to evaluate the effect of the policy of funding free part-time childcare for all 3-year-olds. We report our results in Table 2 for the whole sample, as well as separately for boys and girls and for children eligible and not eligible for free school means. The coefficients are estimated using linear LEA fixed effects models based on equation (2). The top panel shows effects on standardised points scores in the Foundation Stage Profile (FSP) and the six learning areas within the FSP at age 5. The middle and bottom panel of Table 2 show effects of free childcare availability on the proportion of children reaching expected and higher levels, respectively.

Looking first at the age 5 outcomes displayed for all children in the first column of the top panel of Table 2, the results show that availability of free childcare has a positive effect on several outcome measures: A 10 percentage point increase in the proportion of 3-year-olds for whom free preschool is available leads to an increase in the FSP score of 3.5% of a standard deviation. Positive and statistically significant effects of around 2% of a standard deviation are also found for the learning areas numeracy (problem solving, reasoning and numeracy) and social (personal, social and emotional development) as well as for literacy (communication, language and literacy, at the 10% level). In the time-period included in

these estimates (six cohorts of children aged 3 in 2002-2007) the coverage with funded places increased from 63% to 87% which would correspond to an increase in FSP scores by 7-8% of a standard deviation. In the time-period from the year before the implementation of the free places for 3-year-olds, 1999, to the last cohort covered in our data, 2007, the increase in free places was from an average of 36% to 87% which would indicate an improvement in FSP scores by about 18% of a standard deviation if we are prepared to assume linear effects across all children benefitting from free places.

The FSP results by gender in the top panel of Table 2 suggest that boys benefit more from availability of free preschool places than girls. Results are positive and statistically significant for boys in the FSP score and in most learning areas with the exception of creative development and of physical development where the effect is statistically significant at the 10% level only. For girls there is a positive effect on the FSP score (and at the 10% level on numeracy and social development) only, and the point estimates are consistently lower for girls. Differences in the effect of nursery attendance by gender are a fairly common finding in the literature (see for example Havnes and Mogstad, 2011; Felfe et al. 2012; Datta Gupta and Simonsen 2010), but most authors find that girls benefit more from early education than boys. It is however unclear how these differences come about and why boys benefit more than girls in England.

Comparing children eligible and not eligible for free school meals (FSM), our indicator of low income families, we see that children from higher income families have positive and statistically significant effects of free childcare availability on FSP scores and numeracy scores, whereas any effects on children from low income families are at the margin of statistical significance. This may be because the effects on FSM children are imprecisely estimated because of the small proportion of fsm children in the sample (17.6%), or it may indicate that the benefits of free pre-school availability are higher for higher income children.

Results for children aged 7 are displayed in the middle and bottom panels of Table 2. Coefficients indicate the percentage point increase in the proportion of children reaching expected and higher levels, respectively, for a 10 percentage point increase in free childcare coverage. Regarding children reaching expected levels at the end of Key Stage 1, we see that there are positive effects across the sample of all children on Writing but not Reading and Mathematics. The size of the increase is very small, a 10 percentage point increase



in availability of free places increases the proportion of children reaching expected levels in Writing by just 0.16 percentage points, this corresponds to a 0.2% increase with respect to the mean of the dependent variable (82%). Looking at the results by gender and FSM eligibility, we find that the small positive effects on Writing seem to be driven by boys and higher income children. Moreover, we find small positive and statistically significant results for higher income children on reaching expected levels in all three subjects.

The effect of the availability of free preschool on children aged 7 are somewhat larger for the proportion of students being classed as highly able (see bottom panel of Table 2). Here we find positive effects of a 10 percentage point increase in free childcare availability of 0.2-0.3 percentage points, which corresponds to a 1% (1.4%) increase in Reading (Writing) with respect to the mean of 26% (13%). Results by gender indicate that the % increase in the proportion classed as highly able is slightly larger for boys than for girls, and results by free school meal status indicate that the benefits of free childcare availability are concentrated on higher income children.

In summary, results of reduced form estimates suggest that the introduction of free nursery places for all 3-year-olds in England has improved child outcomes at age 5 in some learning areas, and these effects are larger for boys than for girls and likely for children from higher than lower income families. Although the magnitude of the effects at ages 5 and 7 are not directly comparable, and outcomes measured at age 5 do not correspond directly to those measured at age 7, it seems that the positive effects have largely faded out by age 7. Moreover, they pertain to children at the higher end of the attainment distribution (highly able children), and are concentrated on children from higher income families. Taken together this indicates that the positive effects of the policy are fairly shortlived, and do not contribute to narrowing the attainment gap between children from low and higher income families. If anything, these differences appear to be exacerbated by the policy.

## 5.2 Instrumental variable estimates

We now turn to the effect of attending childcare at age 3 on outcomes at ages 5 and 7. We instrument childcare participation with the proportion of children for whom free childcare for 3-year-olds is available in their LEA of residence. Table 3 shows the first stage relationship in the top panel, estimated using linear LEA fixed effects estimation. The coefficient of

the availability of free places is 0.23, indicating that for every ten places funded through government, an additional 2.3 places are taken up, and the remainder of the funding goes into places that were already being taken up but privately paid for. Thus the net effect on the policy on childcare attendance has been modest. The first stage coefficient is statistically significant at the 1% level and the value of the F statistic exceeds the value considered critical in the literature (Stock and Yogo 2005). Moreover, the partial  $R^2$  is relatively high at about 30% of the total  $R^2$  so that our instrument satisfies the condition of relevance. Note that we do not have a measure of availability of free places that distinguishes children by gender and free school meal status.

The second to fourth panels of Table 3 display results of LEA fixed effects instrumental variable estimates, one panel for effects on standardised FSP scores and sub-assessments at age 5<sup>13</sup>, and two on the proportion of children attaining expected and higher levels, respectively, at age 7. We display fixed effects estimates based on equation 3 and corresponding fixed effect IV estimates. For most outcomes, the FE estimates indicate that childcare attendance has no association with child outcomes, with the exception of FSP scores which according to the estimates are 5.3% of a standard deviation higher for children having attended preschool at age 3. In contrast, the corresponding FE IV estimates are positive and statistically significant for most outcomes, pointing to negative selection of children into childcare. As pointed out in Section 3, a downward bias on the FE estimates is in line with expectations because our compliers are children of parents that are reluctant childcare users.

The FE IV estimates displayed in column 2 of Table 3 show that attending preschool increases standardised FSP scores both for the total FSP and the learning areas literacy, numeracy and social development. The sizes of the effects are about 4 times larger than the reduced form estimates displayed in Table 2: A 10 percentage point increase in children attending preschool at age 3 causes an increase in the total FSP score of 12% of a standard deviation and in the learning areas literacy, numeracy and social development of 5-7% of a standard deviation. At age 7 there is a positive and statistically significant effect of preschool attendance on the proportion of children reaching expected levels in Writing with an increase of 0.67 percentage point per 10 percentage points increase in childcare attendance. This corresponds to a small effect of 0.82% with respect to the mean of this variable (13%). As in

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<sup>13</sup>We focus on the total FSP score and the learning areas literacy, numeracy and social development because these were the outcomes most affected by childcare in the reduced form estimates.

the reduced form estimates, the positive effects are higher for the more able children. A 10 percentage point increase in children attending preschool at age 3 increases the proportion of children classed as highly able in Reading and Writing by 1.1 and 0.8 percentage points. This corresponds to increases of 4.2% and 6.0% with respect to the mean (26% and 13%). The positive effect for Mathematics is statistically significant at the 10% level only. The FE IV therefore support the findings of the reduced form estimates which indicate that there are positive effects of attending childcare, but that these are shortlived and largely fade out by age 7. Effects on children at the margin of being highly able are more persistent, but also small.

In Table 4 we display separate FE IV estimates by gender and free school meal status. These need to be interpreted with caution, however, as we do not have separate measures of childcare attendance by gender and FSM status. The results are therefore only valid under the assumption that the first stage relationship holds for all the sub-groups, in other words the response to the offer of free childcare is the same between boys and girls and children eligible and not eligible for free school meals. While we have no reason to think that this may differ by gender, it may well differ between low and higher income families. The demand for childcare may be more price sensitive among low income families, and therefore take-up higher. On the other hand many low-income children were already targeted by free places in the maintained sector before the introduction of universal childcare for 3-year-olds, which would suggest lower take-up.

The analysis by gender seems to suggest that boys benefitted more from childcare participation than girls. At age 5 childcare attendance improved all of the learning areas and the total FSP score displayed in Table 4 for boys, while for girls childcare attendance only improved the total FSP score. At age 7 attending childcare increases the proportion of boys reaching expected levels in Writing, but not of girls. The proportion of children being classed as highly able in Reading and Writing increases for both boys and girls as a result of attending preschool at age 3, but the effects are larger for boys with respect to the mean of the dependent variable (5.3% vs. 2.9% in Reading and 7.2% vs. 4.4% in Writing). The analysis by FSM status suggests that higher income children benefit from attending preschool at age 3, whereas children from low income families do not benefit, under the (strong) assumption

that the relationship between the availability of free places and attending childcare is the same across income groups.

## 6 Conclusions

The UK government spends more than £2 billion every year to provide universal part-time preschool education to children aged 3 and 4. Like many other OECD countries that have introduced universal childcare, the government is hoping to improve child outcomes, narrow attainment gaps between children and increase female labour participation. This paper exploits the staggered introduction of the entitlement to free preschool for 3-year-olds in England to investigate the effect of the policy on child outcomes at ages 5 and 7. We distinguish two effects, the effect of funding childcare places, of interest to policy makers, and the effect of attending preschool.

We find that a 10pp increase in the proportion of 3-year-olds covered by free places improves cognitive and non-cognitive outcomes at age 5 by 2-4% of a standard deviation, with larger effects for boys than girls and for children from higher than lower socio-economic backgrounds. By age 7 the positive effects have largely faded out. Effects on children at the margin of being highly able are more persistent into age 7, but also small. These effect sizes have to be interpreted in the context of the overall increase in coverage by free places, which was 50 percentage points between 1999 and 2007, and 34 percentage points in the time-period covered by our analysis, 2002-2007.

We estimate that in the time-period 2002-2007 for each 10 places that were funded, 2.3 new places (one in four) were created while the remaining places crowded out existing free and privately paid-for childcare arrangements at registered settings. Using the availability of free places as instrument, we estimate the effect of attending preschool when aged 3 on outcomes at ages 5 and 7. Our IV estimates indicate that a 10pp increase in the proportion of children attending preschool at age 3 improves age 5 outcomes by 5-12% of a standard deviation. Effects are larger for boys than girls and mostly fade out by age 7 where small effects on some outcomes remain that are concentrated on highly able children.

Taken together, our results indicate that the entitlement to free places for 3-year-olds has improved child outcomes for children aged 5 but there is a fade-out by age 7 and the benefits

are not the same for all sub-groups: boys benefit more than girls and higher income children more than lower income children. Therefore the policy may have contributed to closing the gender gap in attainment between children, but not the attainment gap between children from different socio-economic backgrounds.

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Figure 1: Percentage of 3-year-olds in preschool education

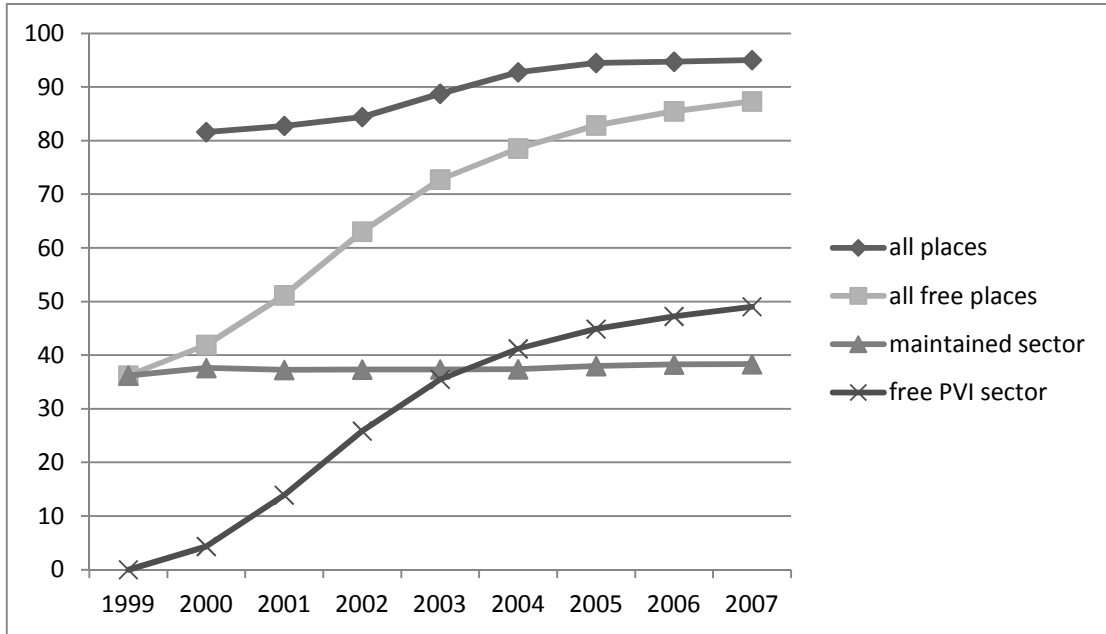




Figure 2: Nursery places for 3-year-olds across England, 2000 and 2007



Figure 3: Types of free nursery places across England, 2000 and 2007



Table 1: Summary statistics for child outcomes at ages 5 and 7

	All		Girls		Boys		FSM		not FSM	
	mean	std dev	mean	std dev	mean	std dev	mean	std dev	mean	std dev
Raw Foundation Stage Profile (FSP) point scores (age 5)										
FSP total	86.33	18.34	89.09	17.14	83.71	19.05	78.04	19.37	87.84	17.74
literacy	25.09	6.85	26.23	6.45	24.00	7.04	21.97	7.05	26.65	6.65
numeracy	20.18	4.67	20.49	4.38	19.88	4.92	18.13	5.13	20.55	4.49
social	20.72	4.27	21.44	3.94	20.03	4.46	19.12	4.50	21.01	4.16
knowledge	6.63	1.61	6.67	1.55	6.59	1.66	6.01	1.75	6.75	1.55
physical	7.17	1.41	7.38	1.26	6.98	1.51	6.76	1.55	7.25	1.37
creative	6.60	1.49	6.92	1.36	6.28	1.54	6.09	1.58	6.69	1.46
Proportion reaching expected level (age 7)										
Reading	0.85	0.36	0.89	0.31	0.81	0.39	0.71	0.45	0.88	0.32
Writing	0.82	0.39	0.88	0.33	0.77	0.42	0.67	0.47	0.86	0.35
Maths	0.91	0.29	0.91	0.28	0.89	0.31	0.80	0.40	0.92	0.26
Proportion 'highly able' (age 7)										
Reading	0.26	0.44	0.31	0.46	0.23	0.42	0.12	0.32	0.30	0.46
Writing	0.13	0.34	0.18	0.38	0.10	0.30	0.05	0.22	0.16	0.36
Maths	0.22	0.41	0.21	0.41	0.26	0.44	0.11	0.31	0.26	0.44

Notes: National Pupil Database, 2003-2010. FSM is eligible for free school meals. 'Literacy' refers to the learning area communication, language and literacy; 'numeracy' is problem solving, reasoning and numeracy; 'social' is personal, social and emotional development; 'knowledge' is knowledge and understanding of the world; 'physical' is physical development; 'creative' is creative development.

Table 2: Effect of availability of free preschool: reduced form estimates

	All	Girls	Boys	FSM	not FSM
Standardised Foundation Stage Profile (FSP) point scores (age 5)					
FSP total	0.0351** (0.011)	0.0302** (0.011)	0.0386** (0.011)	0.0268+ (0.015)	0.0323** (0.011)
literacy	0.0150+ (0.008)	0.0092 (0.008)	0.0192* (0.008)	0.0035 (0.013)	0.0149+ (0.008)
numeracy	0.0199** (0.007)	0.0131+ (0.008)	0.0254** (0.008)	0.0139 (0.013)	0.0187** (0.007)
social	0.0193* (0.009)	0.0184+ (0.010)	0.0216* (0.010)	0.0243+ (0.014)	0.0158+ (0.009)
knowledge	0.0135 (0.010)	0.0063 (0.010)	0.0208* (0.010)	0.0060 (0.015)	0.0120 (0.010)
physical	0.0127 (0.009)	0.0094 (0.010)	0.0171+ (0.010)	0.0035 (0.015)	0.0106 (0.009)
creative	0.0106 (0.010)	0.0086 (0.011)	0.0123 (0.011)	0.0204 (0.015)	0.0072 (0.010)
Proportion reaching expected level (age 7)					
Reading	0.0007 (0.001)	0.0005 (0.001)	0.0007 (0.001)	-0.0001 (0.001)	0.0011* (0.000)
Writing	0.0016* (0.001)	0.0008 (0.001)	0.0020* (0.001)	0.0002 (0.002)	0.0016** (0.001)
Maths	0.0006 (0.000)	0.0003 (0.000)	0.0008 (0.001)	-0.0016 (0.001)	0.0007* (0.000)
Proportion 'highly able' (age 7)					
Reading	0.0026** (0.001)	0.0021* (0.001)	0.0029** (0.001)	0.0011 (0.001)	0.0025** (0.001)
Writing	0.0018** (0.001)	0.0019* (0.001)	0.0017** (0.001)	0.0003 (0.001)	0.0022** (0.001)
Maths	0.0014+ (0.001)	0.0011 (0.001)	0.0016+ (0.001)	0.0004 (0.001)	0.0016+ (0.001)
N	888				

Notes: National Pupil Database, 2003-2010. Linear regression with LEA fixed effects and weights applied. Availability of free preschool is scaled from 0 to 10, so that a unit increase indicates a 10% point increase in available places. FSM is eligible for free school meals. 'Literacy' refers to the learning area communication, language and literacy; 'numeracy' is problem solving, reasoning and numeracy; 'social' is personal, social and emotional development; 'knowledge' is knowledge and understanding of the world; 'physical' is physical development; 'creative' is creative development. +  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ . Standard errors between parenthesis.

Table 3: Effect of attending preschool: FE IV estimates

		First Stage
Free places		0.2342** (0.023)
F		102.51
$R^2$		0.70
partial $R^2$		0.21
		FE IV
Standardised Foundation Stage Profile (FSP) point scores (age 5)		
FSP total	0.0533** (0.019)	0.1212** (0.038)
literacy	0.0145 (0.013)	0.0546* (0.026)
numeracy	0.0142 (0.013)	0.0716** (0.025)
social	0.0275+ (0.016)	0.0692* (0.032)
Proportion reaching expected level (age 7)		
Reading	-0.0019+ (0.001)	0.0031 (0.002)
Writing	-0.0009 (0.001)	0.0067* (0.003)
Maths	-0.0007 (0.001)	0.0026 (0.002)
Proportion 'highly able' (age 7)		
Reading	0.0019 (0.002)	0.0109** (0.003)
Writing	0.0020 (0.001)	0.0078** (0.003)
Maths	0.0001 (0.002)	0.0058+ (0.003)
N	888	

Notes: National Pupil Database, 2003-2010. 2SLS estimates with LEA fixed effects and applying weights. Preschool attendance instrumented with availability of free places. FSM is eligible for free school meals. 'Free places' is the proportion of children covered by funded places in each LEA. 'Literacy' refers to the learning area communication, language and literacy; 'numeracy' is problem solving, reasoning and numeracy; 'social' is personal, social and emotional development. +  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ . Standard errors between parenthesis.

Table 4: Effect of attending preschool: FE IV estimates for sub-groups

	Girls	Boys	FSM	not FSM
Standardised Foundation Stage Profile point scores (age 5)				
FSP total	0.1024** (0.038)	0.1289** (0.037)	0.0714+ (0.037)	0.1123** (0.039)
literacy	0.0340 (0.028)	0.0670* (0.027)	0.0125 (0.032)	0.0524+ (0.027)
numeracy	0.0469+ (0.027)	0.0883** (0.026)	0.0389 (0.033)	0.0659* (0.026)
social	0.0645+ (0.033)	0.0751* (0.032)	0.0661+ (0.037)	0.0556+ (0.033)
Proportion reaching expected level (age 7)				
Reading	0.0020 (0.002)	0.0030 (0.003)	-0.0004 (0.004)	0.0047* (0.002)
Writing	0.0036 (0.003)	0.0084* (0.004)	0.0008 (0.005)	0.0072** (0.003)
Maths	0.0014 (0.002)	0.0033 (0.002)	-0.0052 (0.004)	0.0032+ (0.002)
Proportion 'highly able' (age 7)				
Reading	0.0089* (0.004)	0.0122** (0.003)	0.0037 (0.003)	0.0112** (0.004)
Writing	0.0080* (0.004)	0.0072** (0.002)	0.0009 (0.002)	0.0099** (0.003)
Maths	0.0046 (0.004)	0.0065+ (0.004)	0.0012 (0.003)	0.0069+ (0.004)
N	888			

Notes: National Pupil Database, 2003-2010. 2SLS estimates with LEA fixed effects and applying weights. Preschool attendance instrumented with availability of free places. FSM is eligible for free school meals. 'Free places' is the proportion of children covered by funded places in each LEA. 'Literacy' refers to the learning area communication, language and literacy; 'numeracy' is problem solving, reasoning and numeracy; 'social' is personal, social and emotional development. +  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ . Standard errors between parenthesis.