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Quality in Early Years Settings and Children's School Achievement

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Abstract
Childcare quality is often thought to be important for influencing children's subsequent attainment at school. The English Government regulates the quality of early education by setting minimum levels of qualifications for workers and grading settings based on a national Inspectorate (OfSTED). This paper uses administrative data on over two million children to relate performance on national teacher assessments at ages 5 and 7 to the quality characteristics of the nursery they attended before starting school. Results show that staff qualifications and childcare quality ratings have a weak association with teacher assessments at school, based on comparing children who attended different nurseries but attended the same primary school. Our results suggest that although children's outcomes are related to the nursery they attend, which nurseries are good cannot be predicted by staff qualifications and OfSTED ratings; the measures of quality that Government has focused on.

Keywords: childcare quality, educational attainment
JEL codes: J13; I20

1. Introduction

Government sponsored expansion of childcare and/or provision of childcare subsidies are very popular policies around the world (Cascio, 2015). These policies are often motivated by a desire to facilitate maternal employment, although there is also a belief that pre-school and childhood programmes are beneficial for child development. In the English case, the extension of state support for childcare in the pre-school years aimed to produce a 'double dividend', by both promoting child development and encouraging maternal employment (Strategy Unit, 2002, p.29). [1] The English Government spends £2 billion a year on providing free part-time nursery education for three and four year olds, known as the 'free entitlement'. An evaluation of the extension of the policy for 3 year olds in the early 2000s found disappointing results, with no educational benefits beyond the age of 5 (Blanden et al. 2016).

The current literature on early education and care reaches two important conclusions. First, investing early in disadvantaged children can have substantial returns (Cunha et al. 2006). Second, the pre-school experience needs to be 'high quality' to have the most beneficial effects (Cascio, 2015, Sylva et al. 2010, Melhuish et al., 2010). Work by James Heckman and others provides the conceptual foundation for the idea that early interventions have the potential to be effective for the most disadvantaged. For example, Cunha et al. (2006) demonstrate that gaps in cognitive skills emerge at early ages and establish that intervening early allows children to more effectively build later skills. Small scale trials of intensive interventions on very young disadvantaged children have revealed impressive long-term benefits (Barnett, 1995; Karoly et al., 2005; Heckman et al., 2010). Greater benefits for more disadvantaged children have also been found for some universal programmes (Havnes and Mogstad, 2011, Felfe et al., 2015, Felfe and Lalive, 2014), although evidence on this point was found in Blanden et al., 2016 to be rather weak for England; with no long-term benefits for any identifiable group.

It is frequently discussed in the literature that benefits are only found from 'high quality' programmes (Cascio, 2015). This conclusion is generally reached by comparing the features of programmes with benefits for children's outcomes such as those in Norway (Havnes and Mogstad, 2011), Spain (Felfe et al 2015) Oklahoma and Georgia (Cascio and Whitmore-Schazenbach, 2013), with those with no benefits such as Quebec (Baker et al., 2008), and Danish family care (Datta-Gupta,2010). Cascio (2016) compares US states and finds that

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[1] Early years and education policy is a matter for devolved nations, although policies are very similar across the four nations. Our data and discussions focus on England.

universal systems have much greater benefits for disadvantaged children than targeted programmes. However, she finds it hard to identify the precise features of universal systems that lead to their success. Our findings here echo this result.

It has been noted that the expansion of early education in England did not have a strong focus on quality (Blanden et al., 2016, Gambaro et al., 2015), and this might provide one explanation for the lack of impact from the free entitlement. A unique feature of the free entitlement in England is that the expansion relied exclusively on private settings to provide the new places. Education researchers have devised rating scales of the quality of children's experiences based on systematic observations of classroom practice and adult-child interactions. Using these measures of process quality, private nurseries are found to be of lower quality than public ones, prior to the introduction of the free entitlement (Sylva et al., 2004).

Since the free entitlement became universal in 2004 Government has sought to improve quality by direct inspection and by up-skilling the nursery workforce. All settings are required to be inspected periodically (typically every four years) by the Office for Standards in Education (OfSTED); who assess the quality of the setting in terms of delivering the Early Years Foundation Stage. On qualifications, Government regulates the acceptable qualifications of nursery staff; and while the required level is low the regulations on acceptable ratios allow staff trained to graduate level to be responsible for more children. In addition, there have been public investments to subsidise nursery workers to gain additional qualifications. All of these institutional details will be described in more detail below and in Section 2.

This paper addresses the issue of the quality of English early education directly by using data on three cohorts of children who are observed in preschool in 2008-2010. Information on their preschool experiences is matched with teacher-assessed achievement data at ages 5 and 7 to investigate how the quality of the preschool experience is associated with children's educational outcomes in the early years of primary school. We also consider how this varies for children from different backgrounds and with different needs. Very little work has been done in comparing the influence of different quality features on outcomes within a single system. We seek to fill this gap.

We have the advantage of being able to observe a near census of pupils in primary school and being able to link these children back to their early years' setting. Where children

are observed in the 'private, voluntary and independent' (PVI) sectors[2] (about half of all children), we have information on some features of the early years' settings that they attend – for example, the qualifications of staff, the type of setting, and pupil-staff ratios. Furthermore, we can observe the quality of the early years' setting as judged by the Schools Inspectorate (OfSTED) which awards a grade ranging from 1, outstanding to 4, inadequate for overall effectiveness, as well as subgrades across a number of areas including: leadership and management, quality of provision, and outcomes for children (Mathers et al., 2012).

Much of the policy discussion surrounding the importance of quality for children's outcomes in England is based on evidence from the Effective Provision of Pre-school Education (EPPE), a study of children attending nursery in the late 1990s. It seems important to update these results with information for more recent cohorts. In addition, observational studies such as EPPE, despite controlling for a range of family background measures may suffer from selection bias – if children are selected into settings non-randomly, then it is possible to confuse the impact of the unobserved characteristics of children with the impact of the settings they attend. Although our study suffers from the same problem, and indeed has fewer control variables, we instead control for the infant/primary school that children subsequently attend, so that we are comparing children whose families make similar location and schooling choices. We can also control for the characteristics of other children who attend the same childcare setting. Furthermore, our access to administrative data means our sample sizes are very large and representative of the whole country.

We find that setting attributes and quality (as we can measure it) have very small associations with outcomes. The presence of a graduate in the setting, specifically a qualified teacher, raises children's scores at age 5 and 7 by 2 percent of a standard deviation. Similarly children who attend settings rated 'Outstanding' by OfSTED do about 4 percent of a standard deviation better in the Early Years Foundation Stage than those attending a setting graded 'Satisfactory or Inadequate'. Estimating the results by subgroup reveal limited evidence that quality matters more for the most disadvantaged children. It is unlikely that the small effects found are substantially downward biased as a consequence of the sorting of children into settings.

These results do not mean that 'quality' does not matter for childcare. Rather, they mean that conventional ways of measuring quality, such as OfSTED ratings and staff

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[2] As opposed to those in early education provided in pre-school settings that are attached to primary schools (and fully subsidized by the State).

qualifications do not influence educational outcomes in most setting types. This matters because such standards are often the explicit focus of efforts of government policy to raise childcare quality.[3] In the final section of the paper we present results indicating that children's outcomes vary a lot between childcare settings, conditional on other variables. More research is needed to understand why children in some settings do better than others. The findings here have parallels with the literature on teacher quality which often finds that teacher quality matters but that 'teacher quality' is not mediated by observable characteristics of teachers such as their qualifications (e.g. Hanushek and Rivkin, 2006).

From September 2017, 'working families'[4] will be offered a further 15 hours of free childcare on top of the 15 hours already provided for all children. Pilots began in eight local authorities in September 2016. The clear focus of this policy is to provide assistance to working families rather than improving child development. Johnes and Hutchinson (2016), note that the new policy will mean that the poorest families will have less support for childcare than those higher in the income distribution. Providers have expressed concern about their financial sustainability if they provide 30 hours of Government-funded care, even if this is paid for at slightly higher rates (Pre-school Learning Alliance, 2015). In this environment, providing quality care is likely to become even more challenging; and it is all the more important that we know as much as possible about how nursery characteristics affect children's outcomes.

The next section provides background on the context of the free entitlement in England and Section 3 reviews the current literature on the relationship between children's outcomes, process quality and setting characteristics. Section 4 describes the data used in our analysis while Section 5 uses it to describe the relationship between children's and setting characteristics. Section 6 reports results of models of the association between outcomes and our measures of quality. Section 7 extends our analysis and discusses its likely implications and Section 8 concludes.

2. Institutional Background

In England, children start school the September after they reach the age of 4. Publicly provided schooling and early years' provision have traditionally been overseen by Local

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[3] https://www.gov.uk/government/news/childcare-qualifications-overhaul
[4] Working families are defined as two parent families where both are working the equivalent to 16 hours a week at the National Living Wage (although they can work less if they earn more), and who both earn less than £100,000 each. A single parent will qualify if (s)he meets the working criteria applied to each dual parent (Department for Education, 2015).

Educational Authorities (LEAs), of which there are 152 in England. Before the late 1990s the English Early Years system had three distinct elements: public education, public childcare for the disadvantaged and private and voluntary provision of various types.

Public early education provision was provided by Local Education Authorities (LEAs) on an optional basis. This included classes in state primary schools and, more rarely, stand-alone maintained nursery schools. LEAs were free to choose the number of places and these were more likely to be found in Labour dominated inner-city areas and targeted at the poorest families living within them (Lewis and Lee, 2002). Where available, pre-school education was traditionally provided to children the year before starting school (i.e. primarily for four year olds), although maintained nurseries accommodated younger children as the school starting age reduced through the late 1990s. In 1999, 37 percent of three year-olds were receiving early education in the state sector. State day nurseries were much smaller in number and were provided for longer hours but for a strictly limited group of mothers with particular needs. As maternal employment rates rose, the Private Voluntary and Independent (PVI) sectors offered more full-day care options for mothers alongside an informal network of playgroups providing social opportunities for children for short sessions. In 2000 more than 80 per cent of children were taking advantage of some early education opportunity, either provided by the state or paid for privately (Blanden et al, 2016).

The shift to universal eligibility for part-time education from the late-1990s to mid-2000s occurred in the context of this mixed, and diverse, early years market. Rather than expanding the state sector, the Labour Government opted to fund PVI settings to fulfil the need for early education in those areas without a history of state provision. All settings were subject to regulation and expected to follow a standardised curriculum known as "the Foundation Stage", this was later developed into the Early Years Foundation Stage. This curriculum emphasises learning through play, ensuring that a range of stimulating activities are provided and that children's development is encouraged across a whole range of areas.

Despite this common curriculum, the historical context means that children's experience varies depending on where they take up their place. Funding per hour is higher in the public compared with the private sector (Noden and West, 2016; West and Noden, 2016; National Audit Office, 2012) and there is variation in terms of the duration of a pre-school day. Public provision will usually be restrictive in terms of hours available – often either five mornings or five afternoons – and usually will not extend outside school hours. In contrast, Private Day nurseries often focus on full-time care, so that the entitlement to a free place acts as a discount on fees, with the number of hours taken up by each child being much more

variable. However, this is not true of all PVI settings. For example, settings which evolved from community playgroups (often now branded as pre-schools) generally offer care over more restricted hours: either just morning or afternoon sessions or spanning no longer than a school day in term time only.

Most importantly, there are marked differences between public and private sector providers in respect of staff qualification requirements and adult-child ratios. Maintained nursery schools and nursery classes within primary schools require that a teacher with a degree level qualification is always present, and have an adult-child ratio of 1:13. There is no requirement for a qualified teacher to be present in the private sector, although low qualifications in these sectors have been a focus of policy action. The 2006 Childcare Act created a new qualification Early Years Professional Status (EYPS), designed as a degree level childcare qualification; and an alternative to Qualified Teacher Status for leaders in this field. Funding was then available to settings to train staff to this level with the stated aim that all settings would employ at least one graduate or Early Years Professional (EYP) by 2015. This funding was disproportionately allocated to settings in poorer neighbourhoods, with LEAs in the most deprived areas able to fund two Early Years Professionals per setting, rather than one as in other areas, in order to improve the quality of childcare in these areas (Mathers et al., 2011).

The regulations on ratios give PVI nurseries an incentive to have an EYPS on staff. The presence of an EYPS or qualified teacher allows a setting more flexibility with ratios as they can follow the 1:13 rule applied in maintained settings, although this is only applicable between 8am and 4pm (Gambaro, 2012). In PVI settings without a graduate staff member the adult-child ratio is increased to 1:8 (Gambaro et al., 2015). The minimum standard for qualifications in the PVI sectors are very low with only a general requirement that at least 50 percent of staff must hold a relevant level 2 qualification, which corresponds to approximately two years of post-compulsory schooling.

In order to be awarded EYPS individuals are required to demonstrate that they meet 38 professional standards when working with children from 0 to 5 years old. Training routes vary and accreditation can take from four months part-time to one year full-time depending on the experience of the individual (Mathers et al., 2011). Even the long route is considerably shorter than QTS training which usually takes three years full-time. Notably, the EYPS does not qualify individuals to work as a nursery teacher in the maintained sector.

Gambaro (2012) analyses pay by qualifications and sector and finds the earnings differential of being qualified to graduate level is much lower in PVI sectors compared to the

maintained sector. There are therefore a number of reasons to doubt both the equivalence of the EYPS and QTS qualifications and the comparability of qualified teachers who work in the private and public sector. It will be important that our analysis recognises these important differences in the meaning of these qualifications.

The discussion in this section makes it clear that there is considerable diversity in the English Early Years sector and we might anticipate that this diversity has an impact on the quality of children's experience and their educational outcomes. Our aim in this paper is to provide the first analysis of the importance of setting characteristics for children's outcomes in the context of the free entitlement. Before we do this, we first review the knowledge base on the impact of quality on children's outcomes.

3. Literature review

Discussions of quality in the academic literature usually focus on two dimensions of quality: process and structure (Mathers, et al., 2012). Process quality focuses directly on the activities undertaken as part of the childcare and can be measured through observational rating scales (Mathers et al., 2012). The limitation of these measures is that they are expensive to collect and they are not available in our administrative data. Measures of structure such as staff qualifications, the staff-child ratio and group size, provide an alternative approach (Munton et al., 1995) and, because they are easier to quantify and monitor, are often the focus of government policy, despite being less directly related to children's experiences.

Our study assesses the association between outcomes and structural quality (in particular staff qualifications) and quality as rated by OfSTED; an assessment which is designed to measure the activities of nurseries plus some structural aspects such as space and facilities. OfSTED reports are the main source of information on quality for parents. Just over half of parents in the Childcare and Early Years Survey of Parents said that the inspection results had influenced their decision to use their chosen provider (Kazimirski et al., 2008).

Despite the consensus that quality matters, the evidence on how quality affects children's outcomes is sparser than might be expected. As mentioned in the introduction, conclusions on the importance of quality are mostly based on findings that the universal programmes which show positive effects tend to be those with high staff qualifications and an educational focus (Cascio, 2015). The relevant question in our context is whether variation in setting quality within the same childcare system can be shown to lead to better child outcomes. As Duncan and Magnuson (2013) point out there are few studies that address this question.

Two studies have related process quality to children's outcomes for England: the Effective Provision of Pre-School Education (EPPE) Project, (Sylva et al., 2003, 2004, 2010; Sammons et al, 2003, 2004) and the National Evaluation of Sure Start (NESS) (Melhuish et al., 2010). Both studies are observational and relate outcomes to the quality of the settings parents choose. EPPE considers children attending nursery in the late 1990s while NESS covers children of the same age in the early to mid-2000s. Both find positive, but small, associations between researcher-observed quality and outcomes. The EPPE study is often referenced as providing evidence that quality settings have long term benefits. In fact, Sammons et al. (2004) find that by age 6 and 7 measures of quality in the EPPE data are no longer related to outcomes unless children attending high quality settings are compared to those who did not attend at all. In a world of almost universal attendance, this is not a relevant comparison. Thus evidence on the importance of quality for outcomes is therefore not as strong as we might expect.

Hopkin et al. (2010) is the only paper that relates nursery settings' OfSTED ratings to children's outcomes. Using Millennium Cohort Study data, the authors examine the impact of childcare OfSTED ratings on a range of cognitive tests administered as part of the survey as well as the Foundation Stage Profile Assessments of the children collected from their schools. The authors find OfSTED ratings are not associated with FSP scores or the MCS measures.

Examining the link between OfSTED scores and process quality in 1423 settings across 12 LEAs, Mathers et al. (2012) find that, on average, settings graded as 'Outstanding' by OfSTED achieve higher process quality scores than 'Good' settings, which do better than settings graded as 'Satisfactory'. However, those graded as 'Inadequate' do not always have the lowest quality ratings.   Moreover, correlations between the between the OfSTED ratings and the observational rating scales, while statistical significantly, are weak. The authors note that differences may be related to the fact that OfSTED inspections are based on broad criteria and are based on the whole-setting level, whereas process quality measures relate to the activity in a particular room.

Staff qualifications, an aspect of setting structure, have been emphasized as a route to quality in policy discussions (for example Stewart and Gambaro, 2013). Mathers et al. (2007) find that the average qualification level of staff is positively related to process quality (attracting a standardised coefficient of 0.21) for a subsample of children in the Millennium Cohort Study. The number of trained staff is also positively related to outcomes: the higher the proportion of staff in the setting with a formal level of education, the higher the

process quality (Siraj-Blatchford et al., 2006). There is also some direct evidence that children have better outcomes if there is a qualified teacher in the setting. Positive associations were primarily found for social skills such as being cooperative, sociable and less worried and upset (Mathers and Sylva, 2007). Mathers et al. (2011) are able to assess if up-skilling some members of the nursery workforce to hold Early Years Professional leads to improved quality; a more robust approach. They find that training a member of staff up to EYPS led to significant improvements in process quality. On the other hand, correlational evidence from the US finds little consistent evidence that staff qualifications matter (Mashburn et al., 2008).

Looking at other measures of structure, there is evidence that larger settings have better quality along some rating scales (Mathers et al, 2007) and have better outcomes for children (Melhuish et al., 2010). Melhuish et al. (2010) also demonstrates higher observed quality in settings where the number of children to each adult is lower, although this effect is observed to be quite weak in Mathers et al., (2007).

US States are increasingly adopting quality metrics which combine some of the features of the OfSTED ratings with information on qualification levels. While it does seem to be the case that those states with highly rated pre-school programmes are those with the best evidence of programme effectiveness (Cascio and Whitmore-Schanzenbach, 2013), analysis at the programme level finds a limited association between staff qualifications and programme outcomes, (Cascio, 2016). However, there is consistent evidence of a link between programme outcomes and measures of process quality (Sabol et al., 2013) although there is no claim that this is causal.

To summarise, the evidence on the impact of quality on outcomes indicates rather small associations that are mostly based on correlational evidence and sometimes small and unrepresentative samples. Despite this, there is much public emphasis on OfSTED rankings, and staff qualifications are frequently discussed as crucial factors for childcare policy. Our aim in this paper is to use administrative data to add to the rather scant evidence available on the association between quality measures and child outcomes.

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4. Data

The National Pupil Database (NPD) is a census of students in the state sector.[5] It is possible to follow them longitudinally from the time they start school (at age 4/5) until they leave the education system completely. The data includes teacher assessments of attainment in primary school at age 5 and 7 which we use in our analysis. The NPD can be linked to the Early Years' Census (EYC) for children who attended a pre-school at a private, voluntary or independent setting (which is about 52 per cent of pupils). We observe most other pupils in the maintained sector – which are early years' setting that are located in primary schools and a few standalone settings; their details are recorded in the NPD. The EYC and NPD are both collected every January. We use information from 2008-2011 on children in their preschool year. Information is requested about both the setting/school and the children who attend. Completion of the Early Years Census is compulsory for settings in the Private, Voluntary and Independent sectors who receive funding for providing the free entitlement. As all children are eligible for the free entitlement in the January before they start school, the combination of these two datasets should provide information for all children in a given cohort who receive the free entitlement, and include almost all children resident in England born between September 2003 and August 2006; this amounts to 1.8 million children.

Both censuses collect data at both the establishment-level and the child-level. The establishment level data included in the EYC includes information on staff who are qualified teachers and those who have Early Years Professional Status (EYPS) from the academic year 2008/2009 onwards. Questions on staffing are asked at the whole establishment level and also about those staff who are working with the children who receive the free entitlement. This might be an important distinction if the setting is run by a teacher who has limited day to day contact with children. In our analysis we define both having a graduate 'present' (i.e. in the establishment) and a graduate 'teaching' (i.e. working with the child's particular age group). Information is also collected about the total number of staff (again in the whole setting and working with 3 and 4 year olds) and the total number of children. This information allows us to compute the ratio of children receiving the free entitlement to the adults that work with them. We assume that all children in the maintained sector have access to a qualified teacher and we can find out more information about the setting size and number of staff from administrative data at school level.[6]

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[5] This excludes pupils in the independent sector (which is at most 7% of the population but likely to be lower at a young age.)

[6] This is LEASIS (Local Education Authority Schools Information System) supplemented by the schools' workforce survey for 2011.

Information about individual children in the EYC is limited but includes month and year of birth, sex, special educational needs status and hours attended at the setting[7]. Importantly, both censuses use the same unique child identifiers, which enables us to match children between the datasets. This is useful as it enables us to identify children who appear in both, and keep the observation for the setting where he/she attends for most hours (this is necessary for less than 1 per cent of observations). More crucially, the unique reference number allows children to be matched with their later school records through subsequent school censuses. This provides us with access to their results in teacher assessments at age 5 and 7 as well as (somewhat) more detailed information on their family background. Specifically we have detailed information on children's ethnicity, whether they speak English as an additional language, and their eligibility for free school meals.[8] We also know the Lower Super Output Area where children live, so we are able to match children to the level of deprivation of their area of residence. We observe these characteristics when children are in Year 1 as we find a higher proportion of children registered for Free School Meals in this year.

It is well known that not all eligible children take-up the free entitlement but our match picks up 94 percent of all the children who appear in first year of school (Reception) in the Schools' Census in the following year. This is comparable with information on take up from other sources (National Audit Office, 2012). Appendix Table 1 provides information on the proportion matched by their characteristics in Year 1 (the first truly compulsory year of schooling). The differences in take-up by group are generally quite small. Where differences exist, they are most notable by ethnic group, varying from 88-96 percent for most major groups (White British is 96 percent).

The second column of this Table provides information on the sample characteristics of those who are matched to their free entitlement setting (i.e. the 94 percent). From this we can observe that in Year 1, 19 percent of children receive free school meals, 14 percent have English as an additional language and more than 60 percent are of White British ethnicity, with a sizeable proportion of children (16 percent) having no ethnicity information available. Slightly less than 5 per cent of children have already been judged as having special educational needs.

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[7] This is not available in the maintained sector for 2008 and 2009, but we nonetheless have information on how many hours are funded at maintained settings for this year. This helps us distinguish the primary provider in cases where children attend settings in both the PVI and maintained sectors.

[8] Free school meals eligibility is commonly used as a measure of disadvantage in the UK literature. Its merits and shortcomings are discussed in Hobbs and Vignoles (2010).

We are able to complement the information from the Early Years Census on PVI settings with information on OfSTED ratings. We have data on all assessments made for Early Years settings from 2005-2011. We match the child and their setting to the rating that is closest in time to their preschool year. This may be up to 6 years before we observe the child or up to one year after. 60 percent of the ratings used in our sample are judged no more than two years away from the child's preschool year. Appendix Table A2 reveals the shares of children in the PVI sector who we can match with OfSTED ratings. This is 80 percent overall with few significant deviations by child and nursery characteristics. The exception to this is children who attend independent settings; in this case only half can be matched to an OfSTED inspection.

Our use of the OfSTED data is complicated by the change in the inspection regime in 2008. In the 2005-2008 cycle, childcare settings were inspected on quality of care with judgements based solely on the 14 National Standards for Daycare (DWP and DfES, 2003). Where the childcare provider was eligible to deliver the free early education entitlement, they were also inspected on quality of nursery education. Quality ratings of nursery education focused on the difference provision made to progress towards early learning goals in the six areas of learning and were based on the Curriculum Guidance for the Foundation Stage. An early education judgement was provided in almost all cases for the settings in our sample. In the 2008-2011 cycle all providers were subject to the same regime and a single overall effectiveness judgement. This judgement was formed with reference to the Early Years Foundation Stage. The EYFS had a stronger focus on the child's achievement than was present in the National Standards for Daycare, and was a progression from the Curriculum guidance for the Foundation Stage. Importantly for us, the inspection regime from 2008 is likely to be more clearly aligned with the outcome measured at age five. In our models that relate educational outcomes to Ofsted judgements we condition for the inspection regime, and also compare models where data is divided on the basis of the inspection regime used.

Our main outcome measure is the child's total score on the Early Years' Foundation Stage Profile (EYFSP) (Department for Education, 2008). This is assessed by the child's class teacher at the end of the first year (the Reception Year), so the EYFSP is assessed at age 5. Over the period relevant to this study, the EYFSP was formed of 1-9 ratings against 13 assessment scales. The 13 assessment scales are grouped into six areas of learning: communication, language and literacy (hereafter Literacy); problem solving, reasoning and numeracy (hereafter Numeracy); personal, social and emotional development (hereafter Social Development); knowledge and understanding of the world; physical development and

creative development. We use the standardised total score as well as standardised scores for Literacy, Numeracy and Social Development.[9]

After completing the Early Years Foundation Stage in Reception children move onto Key Stage 1 for two years and we also use Key Stage 1 results as an outcome. This outcome is once again assessed by teachers, using well-defined categories. Following standard practice, we transform National Curriculum levels (7 distinct levels) achieved in Reading, Writing, Mathematics and Science into point scores using Department for Education point scales. Although teachers make their own assessments of students for both the EYFS and Key Stage 1, there is a process in place to ensure that there is a meaningful assessment that is standardised over all of England. Appendix Table 1 indicates that among our matched sample average performance in the Early Years Foundation Stage is 87.5 points out of a possible 117 and in Key Stage 1 it is 62 points of a possible 108.

Both of the outcomes are assessed after children have started school and may therefore be affected by school inputs. The US literature (for example Cascio, 2016, Gormley and Gaynor, 2005) has more commonly assessed children's outcomes at the end of the pre-K year before children start school. Assessing children at the end of one or more years of formal schooling means that we are considering medium rather than very short-run effects. While this may lead to lower estimates, we do not regard it as a weakness of our approach. While it would be interesting to observe *both* short and medium run effects, it is most important to understand if impacts last and if differential quality in preschool leads to different outcomes in the EYFS; supporting this stage of education is their aim and their quality rating from OfSTED is assessed according to how well they deliver the Early Years curriculum.

5. The distribution of quality by child and setting characteristics

Table 1 describes the quality characteristics of the settings children attend, both overall and by child characteristics. The first few lines consider the whole sample, assuming that all those in the maintained sector have access to a teacher, while the remainder of the Table considers the PVI sector only, for which more detail is available. The differences in graduate presence between the full sample and children in PVI settings is stark (66 percent v 35 percent) demonstrating the importance of the regulatory differences already mentioned. In addition, we see that children eligible for free school meals, who speak English as an additional language or who live in the most deprived quintile are all more likely to be taught by a

graduate. This points once again to differences between sectors and the fact that the maintained sector disproportionately caters for those in disadvantaged communities. On average (across all settings) children attend for 17 hours, considerably more than the 12.5 provided through the free entitlement at this time.

The analysis of the PVI sector confirms patterns found in previous literature (Stewart et al., 2015). Only just over a third of children are attending a setting with a member of staff qualified to graduate level; this is slightly lower if we focus only on those cases where a graduate is directly involved in teaching preschool children. The average share of graduates is low at 10 percent of all staff. Qualified teachers are more common than those with Early Years Professional Status (EYPS), which is unsurprising given that the EYPS was a new qualification at this time.

Results by subgroup confirm that most of the quality differential towards the disadvantaged is driven by more disadvantaged children in the maintained sector. Within the PVI sector, disadvantaged children are more similar to other children. About 29 percent of children eligible to receive free school meals (FSM children) attend a setting which has a graduate, compared to 35 percent of all children.[10] As previously found by Gambaro et al. (2015) government policy on improving quality has led to improvements in staff qualifications in nurseries in the most disadvantaged areas.[11] The combination of higher private investment in richer areas and higher public investment in poorer areas means that those living in the richest and poorest 20 percent of areas are more likely to have access to a graduate than those in the middle 60 percent of areas. Children who speak English as an additional language (EAL) and children classified as having special educational needs (SEN), have also benefited from the policy focus on disadvantaged areas, meaning that they are also more likely to be in a setting with a graduate.

The majority of settings (67 percent) are rated as Good by Ofsted, but only 11 percent are judged to be Outstanding. As identified by Mathers and Smees (2014), there is a slight socioeconomic gradient in terms of the OfSTED rating of the settings that children attend. FSM and EAL children attend Outstanding provision 9 percent of the time and children from disadvantaged areas have this experience in 8 percent of cases; compared to 11 percent overall.

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[10] From September 2014, all children in reception, Year 1 and Year 2 are eligible to receive a free school meal. However, for the time period of our study, this only applied to the children of families receiving income support.
[11] Some evidence of this deliberate policy comes from the higher proportion of settings with an Early Years Professional in the most disadvantaged areas.

The last few rows of the Table provides information on the additional characteristics provided in the Early Years' Census. FSM children and children from disadvantaged areas are slightly less likely to attend sessional care (i.e. those settings that do not offer full day care), perhaps because disadvantaged families seeking sessional care are more likely to be able to access this in the maintained sector. Children from most of the relatively disadvantaged groups (ie. FSM, EAL and living in the most deprived quintile) are likely to experience a slightly worse staff-child ratio whereas children identified as having special educational needs are in settings with a lower ratio on average.

Table 2 reports the distribution of children across type of setting, which drives some of the patterns found in Table 1. This shows that 48 percent of those receiving the free entitlement in their pre-school year are doing so in the maintained sector, with the vast majority of these children attending nursery classes in primary or infant schools and a further 5 percent of children attending stand-alone nursery schools. We show figures for six distinct PVI types, reflecting the historical diversity of the sector: private day nurseries, private preschools, private/voluntary nursery schools, voluntary preschools[12] local authority day nurseries and Sure Start/Family/Children's Centres.[13] The most popular type of PVI provider is day nursery with 22 percent of pre-school children attending this type. The next most popular are pre-schools provided by voluntary organisations (13 percent), followed by private pre-schools (9 percent) and independent schools (3 percent). A small number of children attend a private/voluntary nursery school (2 percent) and even fewer attend LA day nurseries (1 percent) and Sure Start/Family Centres (1 percent). A very small number of children attend settings specified as 'Other' while a further 1.5 percent are known to be in the PVI sectors but their setting type is unknown.

Table 2 shows that the type of settings attended varies quite considerably by the children's characteristics. Given the history of nursery education in England (described above), it is not surprising to see that almost 80 percent of children in the most deprived 20 percent of areas attend maintained nursery classes. Similar results are found for FSM (70 percent) and EAL children (77 percent). Further investigation shows that differences

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[12] The distinction between day nursery and preschool is driven by the flexibility of opening hours. The precise characteristics of those settings which classify themselves as nursery schools is less clear. We might imagine they are have more of a focus on education rather than care and have purpose built facilities.

[13] Sure Start Centres were set up from the late 1990s to support families in poorer areas (Eisenstadt, 2011). These later became Children's Centres and became more widespread before facing mergers and closures in more recent years (primarily after our sample period). Childcare was not provided by all Children's Centres, and was most likely in disadvantaged areas. Sure Start Children's Centres had broader objectives than childcare and their inspections reflected these, having a broader remit than those of standard childcare settings (DfE, 2010).

between children in access to the maintained sector are primarily driven by differences across areas. There are also important differences within the PVI sector, with FSM children and those with special education needs relatively more likely to attend voluntary pre-schools and less likely to attend day nurseries. Maintained nursery schools, although rare overall (5 percent of all children attend), are more likely to be used by FSM children (7 percent), children from disadvantaged areas and EAL students (8 percent of both these groups).

To complete our investigation of the relationship between children's characteristics, quality and setting types, Table 3 presents information on how quality varies by the type of setting attended for those in the PVI sectors only (i.e. 53 percent of children). There is considerable variation in characteristics by type of setting. Independent Schools have the best qualified staff by far, with nursery schools in second place, again far above other types. Children in voluntary pre-schools are the least likely to have access to a graduate, and almost 70 percent of these settings are sessional. Private pre-schools are similar, though a little more likely to have a graduate. It is noticeable that these two types have slightly lower staff-child ratios, which is likely to be driven by the regulatory link between staff qualifications and acceptable ratios.[14] Given their educational focus, it is not surprising to see that nursery schools have the highest OfSTED ratings with 17 percent classed as Outstanding compared to 12 percent overall. Pre-schools (whether voluntary or private) are likely to have evolved from playgroups and are more likely to be sessional and attended for shorter hours. Local Authority Day Nurseries and Sure Start/Family Centres have better qualified staff on average; this is likely to be consequence of their close relationship with local authorities; and the targeted investments discussed in Section 2.

The analysis reported above includes information on the experience of children with Special Education Needs. These children are also less likely to have a graduate in the setting (30 percent compared to 35 percent overall) and slightly less likely to be in a 'Good' or 'Outstanding' setting, (76.5 percent compared to 78 percent overall). However it should be noted that being classified as having Special Educational Needs is not exogenous to the nursery experience. Analysis in Tables 2 reveals that children who are classified as SEN are more likely to be found in maintained settings and results not shown here indicate that those classified as being SEN in their pre-school year are overwhelmingly found in maintained settings and more likely to be in Outstanding settings when they are in the PVI sectors. This

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[14] As discussed in Section 3, settings without a graduate require a ratio of 1:8 while those with a graduate need one adult per 13 children.

indicates that the ability to identify and statement SEN children is likely to be a mark of a higher quality nursery, or at any rate one with closer links to the school system. SEN can therefore be thought of as an outcome measure and we do not control for it in our main models.

Our initial examination of the matched administrative data confirms the patterns demonstrated by previous research from both Gambaro et al. (2015) and Mathers and Smees (2014): structural measures of quality in settings vary considerably depending on their type and where they are. In general, quality in the PVI sectors as measured by staff qualifications is rather low while OfSTED ratings provide a more optimistic measure of quality. In the next section we relate these measures to children's outcomes.

6. Pre-school characteristics and children's outcomes

Methodology

In this section we run regressions of children's outcomes at ages 5 and 7 on the characteristics of the early years' setting they attended. Our outcomes are standardised measures within each cohort (i.e. with mean zero and standard deviation of 1). We examine total scores at age 5 before investigating associations within each particular area of learning. We also explore associations at age 7, showing some models which condition for age 5 performance to see if nursery characteristics are related to the trajectory of development after age 5. We first run models that control only for the cohort; these provide an overview of the raw association between outcomes and setting type and quality.

$$Y_{ijkc} = \alpha + \beta Q_{jc} + \gamma_c + u_{ijkc} \qquad (1)$$

Thus we estimate a regression of the outcome measure (Y) on institutional characteristics (Q) in setting j for child (i) in cohort c who attends school (k).

However, as mentioned in the introduction, any raw association between setting characteristics and outcome is likely to partly reflect selection to settings; of both children and staff. Parents select their children's early years' provider according to family and child needs. In particular, some types of provider are more suited to families where both parents are working (i.e. longer and more flexible hours). Since we do not have information on parental employment, earnings or education, the association, for example, between children's outcomes and their attendance at private provision without a graduate could also reflect the effect of their parents' characteristics (in this case, higher human capital but less time to spend with their children – requiring the selection of a pre-school provider that can

accommodate long hours). Within PVI settings there may be competing forces at work; higher income parents are able to buy higher quality but Government investment on improving the qualifications of nursery staff has been focused on the poorest areas, as discussed in Section 2.

We adopt several strategies to deal with these complex selection issues, although we are unlikely to be able to eliminate them completely. The first approach we use is to include controls for the primary school attended through school fixed effects. Adding these fixed effects means that to the extent that selection into early childcare settings is also correlated with selection into primary schools we should be able to net this out. In practice, this means that we are comparing children who live reasonably close to each other and attend the same primary school but attend a different early childcare provider. There is a good deal of variation in settings attended within school cohorts with a mean of 21 settings represented within a school. However, many of these contribute very small numbers of children with, on average, one quarter of children in each school cohort coming from each setting.

We also control for the information we have on individual children: gender, month of birth, whether children receive free school meals in Year 1, the level of deprivation in the area of residence (i.e. the deprivation decile of residence), detailed ethnic group, and whether English is spoken as an additional language. In addition, we derive measures for the peers of these children based on the characteristics of the other children who attend the same setting in the same year. These additional controls further allow us to control for differential selection of children into different settings (Altonji and Mansfield, 2015). Our preferred specification is:

$$Y_{ijkc} = \alpha + \beta Q_{jc} + \delta X_{ijkc} + \theta \bar{X}_{jc} + \mu_k + \gamma_c + u_{ijkc} \qquad (2)$$

Where Q represents quality characteristics; X is a vector of child/family characteristics; $\bar{X}$ represents the mean characteristics of the peers of children in early childcare settings; μ_k is a primary school fixed effect and γ_c is a cohort dummy.

Results

Our first models shown in Table 4 consider the link between staff qualifications in the early years setting and the child's performance in the teacher (EYFSP) assessment at age 5. As

before we first consider children in all settings, before focusing on those attending settings in the PVI sector.[15]

The model for children in all settings initially indicates that there is a negative link between higher staff qualifications and children's outcomes (i.e. estimating equation 1). However, once we control for the primary school attended (i.e. equation 2), these negative associations disappear. The negative correlation arises because of the strong connection already observed between local deprivation and the availability of places in the maintained sector. When we control for all characteristics, we see a positive association of being taught by a graduate and test scores at age 5. The magnitude is small at just under two percent of a standard deviation.

For children in the PVI sector, the raw (positive) association between whether a graduate is employed and the setting and test scores may partly reflect the selection into graduate settings among the most and least advantaged. The raw association is modest, at 5 percent of a standard deviation. When controls are added, results are similar to the model which also included maintained schools. We experiment with different specifications. For example, we control for whether more than one graduate is employed and the specific qualifications of teaching staff. This shows that 'qualified teacher status' is driving the association here and not Early Years Professional Status, providing further evidence for the hypothesis that the two qualifications are not equivalent. We are also able to demonstrate that additional graduate level staff are not associated with better outcomes.[16]

Figure 1 shows the association between having a graduate present and a range of different outcomes for children in the PVI sector. Although all associations are small, graduate presence appears to be more important for academic outcomes, especially Literacy at age 5 and the total Key Stage 1 results at age 7. Although there is a positive association between graduate presence and outcomes at age 7 (i.e. Key Stage 1), this is fully absorbed by scores at age 5 (i.e. the coefficient goes to zero once EYFSP is controlled for).

Table 5 reports findings for the regressions of the main age 5 outcome on OfSTED ratings (where the baseline category is 'Good'). Again, associations are small in

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[15] We have experimented with clustering the standard errors at school and setting level. The impact of doing this is very minor on such a large sample.

[16] It is also possible to use threshold measures such as children achieving a 'good level of development', defined as achieving the expected level in literacy, numeracy, physical and social development. We have estimated our models based on these thresholds and still find very small effects. Save the Children (2016) reports the impact of matching achievement measured in this way to graduate presence from the EYC. This study does not account for setting composition and school fixed effects and therefore reports slightly higher (although still small) effects.

magnitude; the raw associations indicate that children in settings judged as 'Outstanding' do 6 percent of a standard deviation better than those who attend 'Good' settings. The negative association of being in more poorly rated settings are similar so that the gap between Outstanding and Satisfactory (Inadequate) settings is 11 (12) per cent of a standard deviation. Once we include a more detailed set of controls (i.e. column 4), the positive association of being classified as 'Outstanding' is 2 percent of a standard deviation whereas the negative association of being classified as 'Satisfactory' or 'Inadequate' (compared to 'Good') is of a similar magnitude. Specification (5) adds further controls for inputs; staff qualifications, staff ratios and group size. These show that some of the effects of OfSTED ratings are mediated through the effects of inputs (particularly graduate presence) but only to a small extent.[17]

Figure 2 once again compares the size of these associations for different outcomes. The association is slightly larger for Literacy at age 5, and for total Key Stage 1 performance (age 7). In addition, there are significant effects for Key Stage 1 conditional on EYFS scores, although the coefficients are extremely small.

Appendix Table 6 provides more detailed results. Specification 1 considers the association between outcomes and a broader range of inputs. When controls are additionally included for the staff-child ratio, if the setting is sessional, its attachment to a school and the number of children on roll the graduate coefficient becomes even smaller at just one per cent of a standard deviation. However, our discussion of the institutional background indicates that graduate presence may be jointly determined with the staff-child ratio, so we think of this as a lower bound. Specification 2 also includes the OfSTED rating and provides the full results from column 5 of Table 5. Both columns highlight the very substantial disadvantage experienced by children on Free School meals who do almost 40 percent of a standard deviation worse than other children. This coefficient serves to further highlight the relatively small magnitude of the coefficients associated with nursery characteristics.

Having established that most associations are small, we now test the hypothesis that they are larger for disadvantaged children. Table 6 shows associations between total EYFSP score and graduate presence. There is no evidence of larger than average effects for any subgroup: associations are always either small or negligible. It is notable that effects for those on Free School Meals or speaking English as an Additional Language are zero. Table 7 shows that EAL children benefit slightly more than average from being in an 'Outstanding'

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[17] Appendix Table 5 reveals that the results are largely unaffected by the change in the OfSTED rating system in 2008.

setting, but coefficients are never greater than five percent of a standard deviation, results for children in receipt of Free School Meals show no association between outcomes and OfSTED ratings.

7. Discussion

Selection concerns

The finding that the presence of graduate staff is very weakly associated with children's outcomes is in strong contrast to the Early Years' policy rhetoric (for example the importance of staff qualifications were stressed throughout the Tickell Review, DfE 20111). It is therefore important to understand its robustness. As our research strategy is not based on exogenous variation we cannot say that the relationship we estimate is causal, however we can think about the direction of the likely bias compared to the true causal effect. For the estimated 2 percent of a standard deviation to be an underestimate of the truth it must be the case that graduates are found in settings that have children who would otherwise do worse than average, conditional on the schools they attend and their own characteristics. Our evidence from Table 1 indicates that there is both positive and negative selection into settings with graduates, but that it is unlikely to be strong in either direction. There is no reason to believe that negative selection is more important than positive selection and it appears unlikely that negative selection on unobservables is large enough to obscure a sizeable positive effect.

Our descriptive analysis reveals that there is substantial sorting of children into different categories of pre-school experience. These choices are likely to depend both on availability where children live and family needs.[18] One further step to address selection is to look within setting type. Tables 8 and 9 provide results for graduates and OfSTED ratings within setting types. In general, results for graduate presence are the same or smaller, supporting our view that negative selection is unlikely to be driving results. The results for Sure Start/Family Centres stand out as being by far the largest. These settings are generally in more disadvantaged areas and graduates' presence is likely to be a result of intervention; the correlation with unobservables within types is therefore likely to be somewhat complicated. Nonetheless, these results may indicate that under certain circumstances graduates can drive

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[18] Results presented in Appendix Table 7 show the associations between setting types and children's outcomes using our standard specifications. Interestingly, once we have dealt with selection to the best of our ability there is no evidence that those attending nursery classes in maintained schools do any better than those in the PVI day nurseries. However, given the substantial selection issues at play these results should be treated with caution.

quality, but as only 1 percent of children are receiving the entitlement in these settings it is not sensible to make too much of them. The results for OfSTED are generally consistent across setting types. Once again Sure Start/Family Centres are the exception, with a significant negative association between being in an 'Outstanding' setting and children's EYFSP outcomes. It is possible that this curious result is a consequence of the unique, broader framework under which Children's Centres are rated (footnote 13).

Setting fixed effects

Our results have shown that the setting characteristics we can measure have weak associations with children's measured outcomes at age 5. This is compatible with two hypotheses: i) either no aspects of nursery quality are strongly associated with these outcomes or ii) this is only true of the characteristics that we can measure and other unobserved aspects of quality do matter. These two hypotheses have very different implications. The first could be seen as a positive outcome if all children are receiving a good standard of pre-school education; or negative if not; but either way there is little can we learn about how quality can be improved from comparing nurseries. The second implies that we need much more study of nursery quality to understand how all settings can reach the highest standards.

Unobserved pre-school setting quality is captured by setting fixed effects. We can therefore rewrite our model as:

$$Y_{ijkc} = \alpha + \beta Q_{jc} + \delta X_{ijkc} + \theta \bar{X}_{jc} + \mu_k + \varphi_j + \gamma_c + u_{ijkc} \qquad (3)$$

Where the model now includes a component, φ_j, attributable to nurseries. These models can be estimated using simultaneous two-way fixed effects models.[19] Effectively these models estimate the average outcome for each nursery conditional on the average at the child's primary school, the child's characteristics and the composition of other children at the nursery. Although we cannot distinguish unmeasured quality from sorting on unobservables

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[19] We use Stata's redhdfe command. More information about this command can be found at http://scorreia.com/software/reghdfe/. Applications of simultaneous two way fixed effects models are Card et al. (2013) and Abowd et al. (2002).

it does give a sense of whether outcomes vary between nurseries and whether there are differences between nurseries that require further investigation.[20]

As the variation in setting level characteristics between cohorts is minimal we actually estimate:

$$Y_{ijkc} = \alpha + \delta X_{ijkc} + \mu_k + \varphi_j + \gamma_c + u_{ijkc} \qquad (4)$$

We can then regress the fixed effects on setting characteristics, allowing the setting effect to be partitioned into a part correlated with observables and an unobservable part, where Q_{jc} includes the full set of setting characteristics (graduate presence, ratio, size and sessional) as well as controls for the setting type.

$$\varphi_j = \vartheta + \pi Q_{jc} + \varepsilon_j \qquad (5)$$

There are various ways the results from these models can be reported. Table 10 follows Card et al. (2013) and uses the results from specifiation (4) to decompose the variation in the EYFSP score into components associated with observed characteristics (X_{ijkc}, $\theta \bar{X}_{jc}$), the setting fixed effect (φ_j), the school fixed effect (γ_c) and the residual (u_{ijkc}). These results show that the variance of the setting fixed effects is smaller than for the school fixed effects, but still amounts to 17 percent of the total variance in the EYFSP.

A more intuitive approach is to use the estimated fixed effects to compare nurseries where children, on average, have better and worse results. If differences are large this indicates that there is variation that we have not been able to explain. To do this we consider the distribution of ε_j, the part of the fixed effect which cannot be explained by observable characteristics. As we might anticipate given previous results, the observed characteristics of nurseries do not do a good job of explaining differences in outcomes so the R-squared for equation (5) is very low. This implies that ε_j and φ_j are very strongly correlated and results are almost identical for both measures.

Table 11 shows show the gaps in standardised EYFSP score associated with moving from a setting at the bottom of the distribution of ε_j to one at the top; varying the cut-offs used. These are compared with the impact of the same shift in the school fixed effect

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[20] By 'sorting on unobservables', we mean that unmeasured characteristics of parents/children might be important for choosing what nursery to send their children (even conditional on primary school, neighbourhood, demographics etc). The 'nursery fixed effect' is likely to capture such behaviour in addition to unmeasured quality characteristics of nurseries that might also influence outcomes.

distribution. This shows that there are substantial differences between nurseries in terms of the association with teacher assessments; there is a 0.416 of a standard deviation gap between the average scores at settings at the 25th and 75th percentile of the distribution of fixed effects. This is equivalent to almost 7 points on the EYFSP; and is much greater than any of the estimated effects of setting characteristics. The magnitude is similar when computed for school fixed effects (although the setting effects are slightly smaller). Although we cannot be sure of the extent to which these differences come from sorting or reflect true unobserved quality there is certainly a great deal of variation between settings. Presuming that the association doesn't fully reflect selection this suggests that setting factors are potentially important for explaining children's outcomes but that the important factors are not the inputs that are conventionally thought of as relevant and often made the subject of policy targets, namely adult-child ratios, teacher qualifications and OfSTED rankings.

8. Conclusions

This paper provides the first comprehensive assessment of the link between children's outcomes and the characteristics of their pre-school experience. The latter is measured by characteristics that are the subject of government policy such as the staff-child ratio and staff qualifications. We find that the associations generally go in the expected direction, but are extremely small. Having a graduate in the setting means that children have a teacher assessment (EYPS) score of one third of a point higher, where the total number of points available is 117. Attending an 'Outstanding' setting is associated with moving up less than one level on just one of the 13 scales that make up the Foundation Stage of primary education at age 5. It therefore seems that commonly used measures of pre-school quality in England are not able to explain much of the variation in children's outcomes at school.

This result is particularly worrying in the light of previous findings that providing free places did not improve children's outcomes in the medium term (Blanden et al., 2016). Clear results on the importance of quality would make it easy to understand the type of investment that needs to be made to improve the impact of government subsidies to early childcare provision. Our results suggest that targets which are often made the subject of government policy (such as qualifications and teacher-student ratios) are not a simple mechanism through which we can expect an improvement in quality (insofar as this is reflected in primary school assessments). However, our results also show that differences between childcare settings are associated with much variation in these same outcomes. Furthermore, the literature on 'process quality' suggests that there are other aspects of quality that matter for children's

outcomes. Our findings are reminiscent of the literature on teacher quality: this matters greatly for outcomes but not on account of readily measured teacher characteristics such as qualifications. Future research requires more focus on what constitutes high quality in an Early Years setting, and a robust approach to analysing its impact on children's outcomes – for example interventions that can be tested by Randomised Control Trials.

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Figure 1: Association of graduate presence with different outcomes
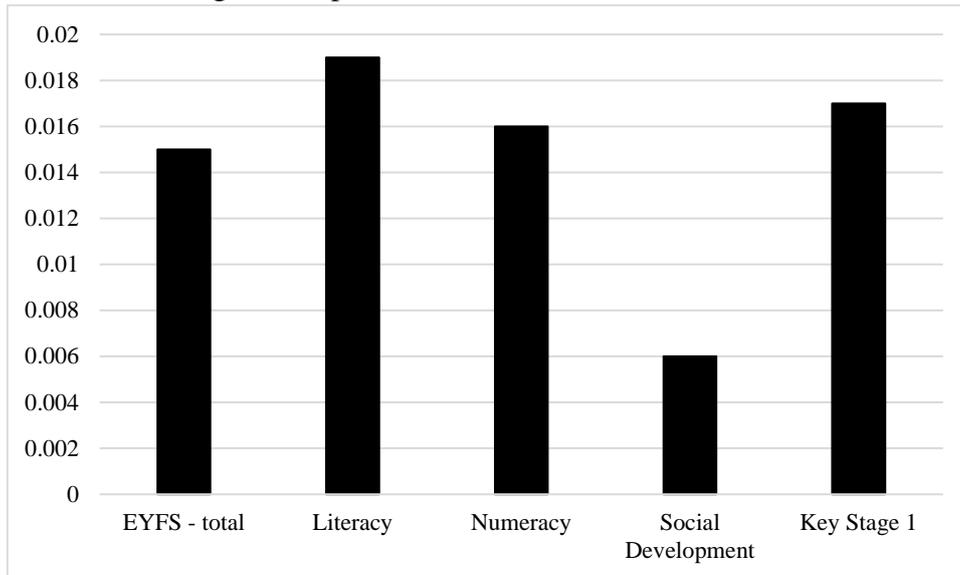
Note: Figure shows coefficients from a regression of standardised scores on graduate presence controlling for school fixed effects, child characteristics and the average characteristics of other children in the setting.

Figure 2: Ofsted rating and different outcomes: compared with good
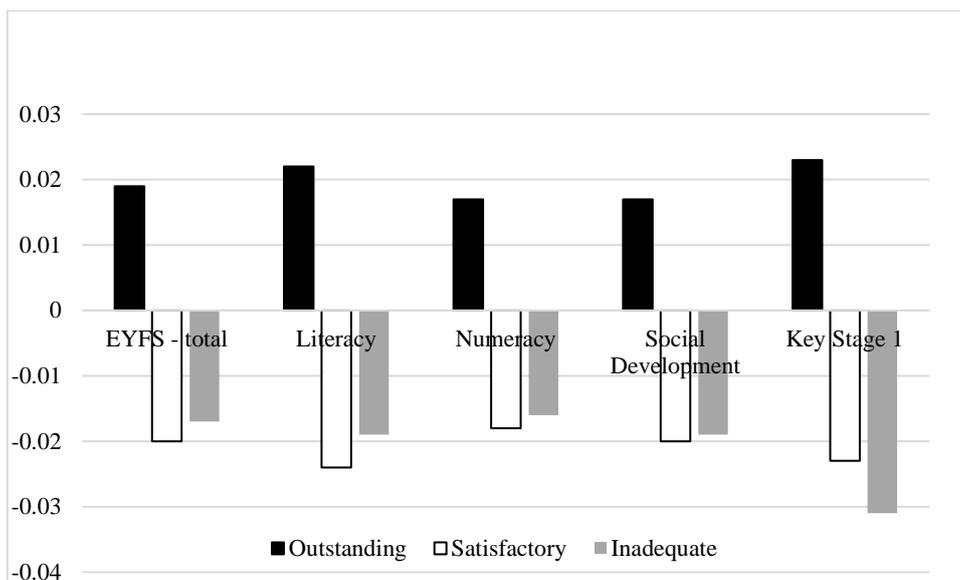
Note: Figure shows coefficients from a regression of standardised scores on graduate presence controlling for school fixed effects, child characteristics and the average characteristics of other children in the setting. All coefficients compare to the base case where the setting is rated 'Good'.

Table 1: Quality characteristics by child characteristics

	All	Eligible for FSM	Least deprived 20% of neighbourhoods	Middle deprived 60% of neighbourhoods	Most deprived 20% of neighbourhoods	English as an additional language	SEN in Year 1
All							
Graduate presence (%)	65.8	79.0	53.3	63.7	85.9	85.0	71.0
Graduate teaching (%)	64.2	78.1	51.2	62.2	85.0	84.1	69.8
Mean hours (standard deviation)	17.1 (9.1)	15.7 (6.8)	16.6 (9.1)	16.5 (8.7)	17.6 (9.1)	16.9 (8.5)	16.2 (8.2)
PVI settings only							
Graduate presence (%)	34.8	29.3	34.0	29.8	34.0	34.5	30.3
Graduate teaching (%)	31.7	26.3	31.1	27.0	29.4	31.2	27.3
Grad overall share (%)	10.1	7.7	8.6	7.7	9.0	9.9	7.8
Any EYPS (%)	17.3	15.7	16.6	15.9	19.3	19.4	16.2
Any QTS (%)	29.2	22.4	28.5	24.0	26.8	27.8	24.5
Both QTS and EYPS present (%)	6.1	5.1	5.8	5.0	6.3	6.9	5.1
OfSTED outstanding (%)	10.9	9.3	11.8	10.8	8.4	9.0	10.4
OfSTED good (%)	67.1	66.1	68.2	67.0	65.5	66.2	66.2
OfSTED satisfactory	20.0	22.5	18.4	20.2	23.7	22.5	21.4
OfSTED inadequate (%)	1.9	2.20	1.7	2.0	2.3	2.3	2.0
Mean hours (standard deviation)	17.9 (10.1)	16.3 (8.5)	17.0 (9.5)	17.3 (9.7)	20.5 (12.2)	19.2 (11.4)	16.9 (9.6)
Attached to school (%)	19.2	25.0	18.1	21.3	19.6	18.6	22.2
Sessional (%)	32.9	37.0	36.9	35.2	26.3	31.8	36.1
Mean number in pre-school (SD)	35.3 (19.7)	34.3 (19.5)	34.9 (17.0)	34.2 (17.5)	33.6 (23.1)	36.9 (25.8)	34.3 (18.6)
Mean staff /child ratio (SD)	6.0 (5.1)	6.2 (5.6)	6.04 (5.1)	6.0 (5.0)	6.6 (6.1)	6.5 (6.4)	5.98 (5.19)

Notes: Statistics are derived from an overall sample of 1,746,495 children born between September 2003 and August 2006. As shown in Appendix Table A1 this is 94% of all children born in this period who attend English reception classes in the expected year.

Table 2: Setting attended by child characteristics

Type of setting and provider	% of sample attending each setting type						
	Full sample	Eligible for FSM	Least deprived 20% of neighbourhoods	Middle deprived 60% of neighbourhoods	Most deprived 20% of neighbourhoods	English as an additional language	SEN in year 1
PVI settings	**52.6**	**29.8**	**71.0**	**50.0**	**21.3**	**23.2**	**42.1**
Private/voluntary day nursery (%)	21.4	10.3	29.7	21.4	9.6	9.8	16.1
Private preschool (%)	8.9	5.5	13.7	9.5	2.7	3.7	7.8
Private/voluntary nursery school (%)	1.9	0.5	2.7	1.4	0.4	0.7	1.0
Voluntary preschool (%)	13.0	8.9	19.1	14.4	4.4	5.2	12.0
Independent school (%)	3.1	0.3	1.7	0.9	0.3	0.7	0.5
LA Day nursery (%)	1.0	1.5	0.5	0.9	1.7	1.1	1.5
Sure Start or Family Centre (%)	1.1	1.1	1.0	1.1	1.1	0.8	1.2
Other (%)	0.7	0.3	0.9	0.7	0.4	0.3	0.5
Type missing PVI (%)	1.49	1.3	1.7	1.6	1.0	0.9	1.7
Maintained settings	**47.4**	**70.1**	**29.0**	**50.0**	**78.7**	**76.8**	**57.8**
Primary infant school nursery class (%)	42.5	63.3	25.9	43.3	70.5	69.0	51.3
Maintained nursery school (%)	4.9	7.1	3.2	4.9	8.2	7.9	6.5

Notes: See Table 1 for description of sample. The percentage of children who attend Independent schools is higher in the full sample compared with the sample who have information available on their area of residence. This is because many who attend independent schools for nursery then go on to attend these schools for Year 1.

Table 3: Quality characteristics by setting type – children attending PVI Settings Only

	All	Private/voluntary day nursery	Private preschool	Private/voluntary nursery school	Voluntary preschool	Independent school	LA Day nursery	Sure Start or Family Centre
Graduate presence	34.7	34.7	26.6	54.7	22.6	88.9	52.9	47.5
Graduate teaching	31.6	30.2	25.0	51.5	21.3	85.1	47.3	42.6
Grad overall share	10.0						12.6	11.0
Any EYP	17.2	20.4	12.1	26.6	10.9	27.5	26.0	25.3
Any QTS	29.1	27.7	21.2	48.9	17.8	88.0	48.6	40.9
Both QTS and EYP present	6.1	6.9	2.7	11.9	2.6	17.3	14.0	11.5
OfSTED outstanding	10.9	11.6	10.8	16.5	9.4	8.0	14.1	9.5
OfSTED good	67.1	66.5	67.9	66.4	67.5	67.8	68.0	69.8
OfSTED satisfactory	20.0	19.8	19.4	15.2	21.2	22.6	16.6	19.3
OfSTED inadequate	2.0	2.1	1.8	1.9	1.9	1.6	1.4	1.4
Mean hours (standard deviation)	18.0 (10.2)	22.3 (12.4)	13.4 (4.2)	17.6 (8.5)	13.0 (3.9)	22.0 (9.2)	20.39 (11.46)	17.0 (9.3)
Attached to school	18.6	11.5	23.9	12.2	28.9	8.8	34.7	19.4
Sessional	33.8	3.2	69.1	32.5	71.4	0	0	41.0
Mean number in pre-school (SD)	35.2 (19.7)	33.0 (16.8)	34.5 (15.6)	41.9 (28.1)	34.0 (16.7)	52.5 (36.7)	36.92	38.2
Mean staff /child ratio (SD)	6.0 (4.9)	6.6 (5.3)	5.3 (3.9)	6.2 (6.8)	5.4 (4.0)	6.06 (4.6)	7.00	7.02

Notes: See Table 1 for description of sample.

Table 4: Total EYFSP score and graduate presence

All settings	(1) Year dummies only	(2) School fixed effects	(3) Plus child Xs	(4) Plus setting composition
Graduate presence	-0.154***	0.003*	0.003***	0.018***
	(0.002)	(0.002)	(0.002)	(0.0015)
Adj R-squared	0.006	0.229	0.334	0.336
Observations	1,599,602	1,599,602	1,599,602	1,599,602
Graduate working in the room	-0.159***	0.001	0.001***	0.018***
	(0.002)	(0.002)	(0.002)	(0.002)
Adj R-squared	0.006	0.229	0.334	0.342
Observations	1,599,626	1,599,626	1,599,626	1,599,626
Children attending PVI settings				
Graduate presence	0.042***	0.024***	0.019***	0.015***
	(0.002)	(0.002)	(0.002)	(0.002)
Adj R-squared	0.001	0.204	0.314	0.317
Observations	791,827	791,827	791,827	791,827
Graduate presence	0.029***	0.019***	0.015***	0.013***
	(0.0027)	(0.0027)	(0.002)	(0.003)
More than one	0.032***	0.013***	0.007**	0.003
	(0.0037)	(0.0036)	(0.0033)	(0.0030)
Adj R-squared	0.0008	0.204	0.328	0.317
Observations	791,827	791,827	791,827	791,827
Qualified Teacher present	0.054***	0.026***	0.019***	0.016***
	(0.003)	(0.003)	(0.002)	(0.002)
Early Years Professional present	0.008*	0.012***	0.009**	0.006
	(0.004)	(0.004)	(0.004)	(0.004)
Both QTS and EYPS in setting	-0.024	-0.002	-0.0001	-0.0003
	(0.007)	(0.006)	(0.006)	(0.006)
Adj R-squared	0.0006	0.204	0.314	0.317
Observations	791,827	791,827	791,827	791,827

Note: Dependent variable is total score in the Early Years Foundation Stage, standardised within each cohort. School fixed effects refer to the school the child attends in reception. Child Xs are gender, month of birth, eligibility for free school meals, detailed ethnicity and speaking English as an additional language. Setting composition is the mean of these variables in the setting the child attends, excluding the child themselves.

Table 5: Association of Ofsted Ratings with EYFSP

Missing category Good	(1) Year dummies only	(2) School fixed effects	(3) Plus kids Xs	(4) Plus composition	(5) Plus inputs
Outstanding	0.057***	0.037***	0.028***	0.023***	0.019***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)
Satisfactory	-0.048***	-0.036***	-0.027***	-0.023***	-0.020***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Inadequate	-0.060***	-0.031***	-0.023***	-0.019***	-0.017***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)
Adj R-squared	.0009	0.205	0.314	0.317	0.317
Observations	791,862	791,862	791,862	791,862	791,862

Notes: As for Table 4. The omitted category is settings with a 'Good' OfSted rating. The models also control for an EYFS OfSted dummy equal to one if the OfSted inspection was made within the Early Years Foundation Stage, after 2008.

Table 6: Impact of inputs by subgroups

	(1) All	(2) Girls	(3) FSM kids	(4) EAL kids	(5) Living in least deprived quintile	(6) Living in most deprived quintile
EYFSP total						
Graduate present	0.016***	0.018***	0.003	0.001	0.020***	-0.015*
	(0.002)	(0.003)	(0.008)	(0.010)	(0.004)	(0.009)
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Child characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Setting composition	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.315	0.311	0.279	0.323	0.332	0.309
Observations	791,877	381,443	89,452	55,651	227,635	64,879

Notes: All regressions include controls for year dummies, school fixed effects, child characteristics and the average child characteristics at the setting as described in the notes to Table 4.

Table 7: Impact of Ofsted Rating by subgroups

Missing category Good	(1) All	(2) Girls	(3) FSM kids	(4) EAL kids	(5) Living in least deprived quintile	(6) Living in most deprived quintile
EYFSP total						
Outstanding	0.019***	0.020***	-0.006	0.045***	0.009	0.020
	(0.003)	(0.005)	(0.015)	(0.018)	(0.006)	(0.017)
Satisfactory	-0.020***	-0.015***	0.002	-0.008*	-0.016***	-0.007
	(0.003)	(0.004)	(0.010)	(0.012)	(0.005)	(0.010)
Inadequate	-0.017***	-0.022**	-0.002	-0.012	-0.024*	0.015
	(0.007)	(0.010)	(0.009)	(0.032)	(0.014)	(0.028)
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Child characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Setting composition	Yes	Yes	Yes	Yes	Yes	Yes
Setting inputs	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.357	0.311	0.281	0.324	0.300	0.310
Observations	791,862	381,443	89,452	55,651	227,635	64,879

Notes: All regressions include controls for year dummies, school fixed effects, child characteristics and the average child characteristics at the setting as described in the notes to Table 4.

Table 8: Impact of inputs by setting type

	(1) All	(2) Private/voluntary day nursery	(3) Private preschool	(4) Private/voluntary nursery school	(5) Voluntary preschool	(6) Independent school	(7) LA day nursery	(8) Sure start or family centre
EYFSP total								
Graduate present	0.019***	0.005	0.007	0.025	0.005	0.048	0.024	0.073***
	(0.002)	(0.003)	(0.006)	(0.014)	(0.006)	(0.031)	(0.027)	(0.022)
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Setting composition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.357	0.318	0.320	0.358	0.311	0.354	0.407	0.374
Observations	791,877	331,000	144,057	23,085	213,431	13,312	15,617	16,647

Notes: All regressions include controls for year dummies, school fixed effects, child characteristics and the average child characteristics at the setting as described in the notes to Table 4.

Table 9: Impact of Ofsted Rating by setting type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Missing category Good	All	Private/voluntary day nursery	Private preschool	Private/voluntary nursery school	Voluntary preschool	Independent school	LA day nursery	Sure Start or Family Centre
EYFSP total								
Outstanding	0.019***	0.030***	0.026**	0.047**	0.027***	0.014	-0.044	-0.087**
	(0.003)	(0.005)	(0.010)	(0.023)	(0.009)	(0.062)	(0.043)	(0.042)
Satisfactory	-0.020***	-0.023***	-0.045***	-0.066***	-0.013**	0.061	0.116	-0.057*
	(0.003)	(0.004)	(0.007)	(0.021)	(0.006)	(0.043)	(0.042)	(0.033)
Inadequate	-0.017***	-0.043***	-0.035*	-0.015	0.027	-0.022	0.086	0.119
	(0.007)	(0.011)	(0.021)	(0.056)	(0.017)	(0.119)	(0.117)	(0.119)
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Setting composition	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Setting inputs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.317	0.318	0.366	0.358	0.311	0.354	0.323	0.278
Observations	791,862	331,000	144,057	23,085	213,431	13,312	15617	16,647

Notes: All regressions include controls for year dummies, school fixed effects, child characteristics and the average child characteristics at the setting as described in the notes to Table 4.

Table 10: Decomposing the Variance of the EYFSP

	(2) Plus kids Xs
$Var(Y_{ijkc})$	0.816
$Var(\mu_k)$ (school fixed effect)	0.138
$Var(\varphi_j)$ (setting fixed effect)	0.051
$Var(\delta X_{ijkc})$ (based on X_{ijkc} and $\bar{X}_{jkc}$)	0.094
$Var(u_{ijkc})$ (residual)	0.519
$2Cov(\delta X_{ijkc}, \mu_k)$	0.012
$2Cov(\delta X_{ijkc}, \varphi_j)$	0.013
$2Cov(\varphi_j, \mu_k)$	-0.011
Sample	787,635

Note: Results are computed from predictions after running a simultaneous fixed effects model using the reghdfe command, as described in the text.

Table 11: Percentile gaps in fixed effects

School effect 90-10	$\mu^{90} - \mu^{10}$	0.430--0.463 = 0.893
Setting effect 90-10	$\varphi^{90} - \varphi^{10}$	0.297--0.339 = 0.636
School effect 75-25	$\mu^{75} - \mu^{25}$	0.221--0.232 = 0.453
Setting effect 75-25	$\varphi^{75} - \varphi^{25}$	0.157--0.155 = 0.412

Note: Percentiles of fixed effects estimated predicted after running a simultaneous fixed effects model using the reghdfe command, as described in the text.

Appendix Table 1: Proportions of subgroups matched

Variable	Proportion with characteristic who are matched with preschool	Proportion with this characteristic in preschool matched sample
All	.938	
Least deprived quintile	.951	.204
Medium deprived quintiles	.937	.600
Most deprived quintile	.920	.196
Autumn born	.943	.337
Spring born	.939	.243
Summer born	.930	.421
Male	.935	.511
Free school meals	.916	.192
English as an additional language	.877	.143
Bangladeshi	.909	.011
Indian	.915	.021
Other Asian	.880	.012
Pakistani	.934	.031
Black African	.880	.026
Black Caribbean	.902	.009
Black other	.886	.005
Chinese	.883	.003
Mixed other	.904	.015
Mixed white/Asian	.919	.009
Mixed white/black African	.908	.005
Mixed white/Caribbean	.931	.011
N/A	.951	.179
Not obtained	.892	.003
Other	.833	.011
Refused	.907	.004
White British	.953	.608
White Irish	.897	.002
White Irish traveller	.607	.0005
White other	.818	.032
White roma	.637	.001
Special educational needs (preschool)	N/A	.045
Special educational needs (Year 1)	.917	.172
Sample	1,862,591	1,746,535
EYFSP total score (standard deviation) [N]		87.47 (16.77) [1,630,669]
Key Stage 1 total points (standard deviation) [N]		61.93 (13.96) [517,890]

Appendix Table 2: Descriptive Statistics for those in matched sample

Variable	Proportion matched to Ofsted (of those in PVI settings)
All	.803
Least deprived quintile	.826
Medium deprived quintiles	.822
Most deprived quintile	.805
Autumn born	.824
Spring born	.822
Summer born	.819
Male	.821
Free school meals in reception	.825
English as an additional language	.789
Bangladeshi	.680
Indian	.808
Other Asian	.805
Pakistani	.836
Black African	.824
Black Caribbean	.802
Black other	.809
Chinese	.815
Mixed other	.819
Mixed white/Asian	.822
Mixed white/black African	.733
Mixed white/Caribbean	.842
N/A	.784
Not obtained	.837
Other	.825
Refused	.815
White British	.797
White Irish	.825
White Irish traveller	.830
White other	.817
White Roma	.825
Special education needs in pre-school	
Special education needs in Year 1	
Private/voluntary day nursery	.824
Private preschool	.813
Private/voluntary nursery school	.784
Voluntary preschool	.838
Independent school	.501
Other	.794
	916,144

Appendix Table 3: Impacts of staffing variables on alternative outcomes

	(1) EYFS total (spec 4 in Table)	(2) Communication, Language and Literacy	(3) Numeracy	(4) Personal, Social and Emotional	(5) KS1 points	(6) KS1 points conditional on EYFS
Any graduate	0.015***	0.019****	0.016***	0.006***	0.017***	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.003)
Adj R-squared	0.317	0.275	0.257	0.300	0.208	0.638
Observations	791,827	791,810	791,773	791,821	248,269	247,064

Appendix Table 4: Impact of Ofsted ratings on alternative outcomes

	EYFS total	Communication, language and literacy	Numeracy	Personal, Social, Emotional	Key Stage 1	Key Stage 1 conditional on EYFSP
Outstanding	0.019***	0.022***	0.017***	0.017***	0.023***	0.012**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.009)	(0.006)
Satisfactory	-0.020***	-0.024***	-0.018***	-0.020***	-0.023***	-0.003
	(0.03)	(0.003)	(0.003)	(0.003)	(0.005)	(0.004)
Inadequate	-0.017***	-0.019***	-0.016***	-0.019	-0.031***	-0.015
	(0.007)	(0.008)	(0.008)	(0.008)	(0.015)	(0.010)
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Child characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Setting composition	Yes	Yes	Yes	Yes	Yes	Yes
Inputs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	791,862	791,845	791,808	791,856	248,280	247,075
Adj R-squared	0.317	0.276	0.261	0.300	0.208	0.638

Appendix Table 5: Checking the impact of different OfSTED ratings

	(1) Pre 2008 OfSTED ranking	(2) Post 2008 OfSTED ranking
EYFSP total		
Outstanding	0.013**	0.023***
	(0.007)	(0.005)
Satisfactory	-0.027***	-0.020***
	(0.004)	(0.005)
Inadequate	-0.025***	-0.027***
	(0.012)	(0.010)
School fixed effects	Yes	Yes
Child characteristics	Yes	Yes
Setting composition	Yes	Yes
Setting inputs	Yes	Yes
Adj R-squared	0.331	0.323
Observations	339,339	309,492

Notes as for Table 5.

Appendix Table 6: Full regression results for all inputs, and Ofsted rating plus inputs

	(1) EYFS total	(2) EYFS total
Outstanding		0.019***
		(0.004)
Satisfactory		-0.020***
		(0.003)
Inadequate		-0.017***
		(0.007)
Any graduate	0.010***	0.009***
	(0.002)	(0.002)
Ratio	0.0008***	0.0009***
	(0.0002)	(0.0002)
Sessional	-0.032***	-0.031***
	(0.002)	(0.002)
Attached to a school	-0.020***	-0.021***
	(0.002)	(0.003)
Number in preschool	0.0006***	0.0005***
	(0.00006)	(0.00006)
In receipt of Free School Meals	-0.368***	-0.367***
	(0.003)	(0.003)
Male	-0.281***	-0.281***
	(0.002)	(0.002)
English as an additional language	-0.174***	-0.174***
	(0.005)	(0.005)
Cohort	Yes	Yes
Month of birth	Yes	Yes
Ethnicity	Yes	Yes
Deprivation decile	Yes	Yes
Setting composition	Yes	Yes
Adj R-squared	0.317	0.317
Observations	768,237	791,862

Appendix Table 7: Association of Setting Type with EYFSP

	(1) Year dummies only	(2) School fixed effects	(3) Plus kids Xs	(4) Plus composition
Private preschool	-0.040***	-0.061***	-0.050***	-0.041***
	(0.003)	(0.003)	(0.003)	(0.003)
Private/voluntary nursery school	0.122***	0.043***	0.031***	0.028***
	(0.006)	(0.007)	(0.006)	(0.006)
Voluntary preschool	-0.080***	-0.090***	-0.070***	-0.059***
	(0.003)	(0.008)	(0.003)	(0.003)
Independent school	0.189***	0.099***	0.069***	0.057***
	(0.008)	(0.008)	(0.007)	(0.007)
LA Day nursery/Sure Start or Family Centre/Other	-0.272***	-0.126***	-0.100***	-0.081***
	(0.005)	(0.005)	(0.046)	(0.005)
Type missing PVI	-0.191***	-0.121***	-0.091***	-0.073***
	(0.006)	(0.006)	(0.006)	(0.006)
Primary infant school nursery class	-0.248***	-0.048***	-0.035 ***	0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Maintained nursery school	-0.298***	-0.109***	-0.084***	-0.053***
	(0.004)	(0.004)	(0.004)	(0.004)
Adj R-squared	0.016	0.202	0.318	0.319
Observations	1,595,372	1,595,372	1,595,372	1,595,372

Notes: As for Table 4. The omitted category is PVI Day Nursery.

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