PRELIMINARY

The effect of free pre-school education on children's subsequent academic performance: Empirical Evidence from England

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Abstract:

This paper addresses the question of whether starting formal education part-time at age 3 has a positive effect on children's academic attainment when they reach age 7, and whether this depends on the sector providing this early education. Using a panel of English Local Education Authorities I initially utilise the fact that mandatory provision of free early education for 3-year olds was introduced at different times according to the deprivation of the LEA and then estimate effects separately for more and less deprived LEAs. Exploiting the time dimension of the panel dataset, I am able to control for unobserved heterogeneity at the LEA level that may confound estimates from other British cohort studies which rely primarily on cross-sectional variation. The main finding is that early education in public sector nursery and primary schools in more deprived LEAs has a small positive effect – approximately 1/3 of a standard deviation of the results distribution – on attainment in reading and writing. These findings suggest that state maintained nursery settings are more effective than private sector providers of early education, especially in more deprived LEAs, which has important implications for the Government's early years education policy.

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1 Introduction

In Western society we need to decide what is the optimal age at which to start educating our children – in most countries the answer is deemed to be between the ages of 4 and 7. But is this efficient? Moreover, does the answer depend on whether the earliest education is provided through the state schools system or contracted out to private nurseries and other private sector settings? This paper sheds light on these questions, exploiting the introduction of a policy to provide free early education places for all 3-year olds in England.

There are strong theoretical motivations for the government to be involved as a provider in the early education sector. Both equity and efficiency arguments plus child development and psychology literature point to the importance of early education for later academic and other socio-economic achievements. Since being elected in 1997, the New Labour government has implemented a number of policies designed to improve the life chances of all children, particularly those with poor initial endowments, and also to allow parents greater access to the labour market through improving childcare availability. Indeed, the first National Childcare Strategy (1998)[1] had these explicit dual aims of improving child outcomes through early experiences and allowing more parents to return to the labour market – and thus raising child incomes, bringing the benefits associated with parental employment and higher family income.

Part of this wider policy agenda has been the introduction of free part-time early education places for all children in England, initially from the age of 4 but subsequently from the age of 3. An early education place consists of a minimum of five sessions of play-based learning per week, each session lasting two-and-a-half hours, for 33 weeks of the year. These places can be accessed at a range of settings and parents can obtain a place for their child at no formal cost to themselves. The policy to introduce these free places for all 4-year olds was introduced in 1998, and at least 96% of all 4-year olds in England were accessing a free early education place by 1999 – the majority of which were in maintained nursery schools or nursery, reception or infant classes in maintained primary schools[2]. Places can be taken in the private sector in which case these providers are paid by the Government via the Nursery Education Grant (NEG).

The Government extended this provision to include 3-year olds, however since the maintained schools sector capacity is filled to a large extent by 4-year olds, much of the expansion has been borne by the 'other' sector – comprising private, voluntary and independent providers and a small number of maintained settings other than nursery and primary schools – and paid for via the NEG. This extension to 3-year olds was introduced in 1999-2000 initially only in the 65 most disadvantaged Local Education Authorities. This was then fully rolled out to all LEAs in 2000-2001, with the aim of providing a free place for all 3-year old children by September 2004.

In this paper I will address the question of whether this expansion of free early education for 3-year olds – largely in the private sector but paid for by the Government – has had a positive impact on educational attainments at Key Stage 1 (KS1), which is the first point at which children take standard national assessments[3] and is therefore a useful benchmark. Using data on each LEA's take-up rate of free early education places in each sector in each year from 1998-2003, and linking this with the results of KS1 assessments in the LEA when the same cohort of 3-year olds took their tests, I create a 5-year panel of data at the level of the LEA[4]. Initially I look at a simple indicator for the policy being in operation and whether this has any effect on overall results in KS1 reading, writing and maths. I then look in more detail at the channels through which the policy operates, estimating the effect that the expansion of places for 3-year olds has had on LEA level results in these subjects. In addition, I allow the impact of the policy

[1] See the First National Childcare Strategy: www.surestart.gov.uk/_doc/0-BB628F.doc
[2] According to figures from "Statistics of Education: Provision for children under 5, January 2002", Tables 3 and 8, and national statistics population estimates.
[3] See figure 1 (on p.5) for an outline of how the Key Stages relate to age and school year.
[4] It is a 5-year rather than 6-year panel due to data unavailability in 2002, see data section.

to differ according to whether the LEA was one of the poorer LEAs that attained the NEG for 3-year olds in the first phase of the policy roll out, allowing me to assess whether the targeted LEAs have benefited more. However, allowing differential impacts inevitably weakens the identification strategy as it reduces one source of variation in the explanatory variable of most interest.

The results indicate that there was little or no impact on reading, writing or maths, of the introduction of the free early education place policy. Looking in more detail at the effect of the increasing attendance of private sector settings by 3-year olds I find no significant effects and this continues to be the case when the impacts are allowed to differ according to whether the LEA was in the first phase of the roll-out. However evidence is found to support the conclusion that, in the poorer LEAs, increasing attendance by 3-year olds in maintained nursery and primary schools has a positive effect on the proportion of children attaining the expected level in KS1 reading and writing, while attendance of these settings by 4-year olds in the better off LEAs is associated with a larger positive effect the proportion of children exceeding the expected level in KS1 reading and writing. This is in line with the findings of the Effective Provision of Pre-school Education (EPPE) project which studied the attainments of 3,000 children in England over a similar time-period. My contribution is to examine whether the implementation of the policy at the aggregate level translates to improved outcomes within the LEA as a whole when the children first sit standard assessments – or whether any effect is mitigated by the first two years of primary school.

The paper proceeds as follows: Section 2 outlines the theoretical arguments for the government's involvement in the early education sector; Section 3 reviews the current literature on the effects of early education on later scholastic and socio-economic outcomes. Section 4 describes the background to the free early education place policy, its historical context, and what it entails. Section 5 details the models, while Section 6 outlines and describes the data. Section 7 presents the results of the estimation and their implications before Section 8 concludes.

2 Why Does the Government Provide Early Years Education?

There are strong motivations for the government to be involved in the pre-school childcare and early education market. The theoretical case for government involvement derives from both equity and efficiency concerns, and is supplemented by an increasing body of empirical evidence both from the US, and to a lesser extent the UK, suggesting that early education programs can have a significant positive effect on children's academic and social outcomes both in the short- and medium-to-long term, especially for children from disadvantaged backgrounds.

From an equity point of view, the government may wish to compensate individuals who have poor socio-economic outcomes and can do so by intervening either to adjust final outcomes or to adjust initial endowments. Aside from cost and efficiency concerns, a further problem with attempting to compensate individuals through altering final outcomes is that this creates severe moral hazard issues – and indeed poverty and unemployment 'traps'. Intervening early to compensate individuals who have unequal endowments in terms of cognitive and non-cognitive skills, environments and opportunities, avoids such moral hazard problems.

It is also argued that market failures – information failures and externalities – can be addressed by the government through involvement in the early education sector. Evidence shows that parents are consistently poor at judging the quality of nurseries and childcare or knowing what factors make for good pre-school settings (Blau & Currie, 2004). This in itself does not justify government *provision* in this area, however, this informational asymmetry is compounded by the failure of parents to recognise and fully capitalise the value of early education for their children which is likely to lead to an under-investment. This is particularly costly to society as well as the individuals, since there are considerable externalities

associated with early education in terms of the human capital of the workforce, social cohesion, and even reduced crime[5].

Moreover, while childcare and early education are slightly different areas, they are necessarily linked. Whilst early education – particularly for disadvantaged children – attempts to address differences in endowments and enhance future prospects, settings providing early education are also providing a substitute for traditional childcare, allowing both parents or the one parent in a single parent family to enter the labour market. This is a considerable motivation behind the current UK government's policy to provide early education – it is part of a package of measures designed to allow parents to return to work and lift themselves and their families out of poverty[6].

While there are these motivations from equity, market failure and externality arguments, they would to some extent be moot if it were not for efficiency considerations with respect to early investments in children – if they are not effective in improving outcomes the arguments in their favour would be much less cogent.

Initial work on human capital (Becker, 1964) treated 'ability' as a fixed genetic feature of which individuals have different endowments. More recent work, drawing on the child development literature, has advanced a more nuanced understanding of cognitive and non-cognitive abilities, how they interact, how they can be developed and the extent to which they are malleable (Shonkoff & Phillips, 2000; Ridley, 2003). However, even if we ignore these aspects, the efficiency arguments for early investment are supported by the fact that investments in children are harvested over a longer time horizon than later investments, making them more cost-effective, *ceteris paribus*.

Moreover, of much greater significance for the efficiency case is recent research, primarily by Heckman and co-authors (Cuhna *et al.*, 2005; Carniero & Heckman, 2003), into the impacts on child outcomes of investments in children made at different times during childhood. This research suggests that investments made early in the child's lifetime are of much greater benefit in terms of medium- to longer-term outcomes – schooling and socio-economic – than investments made later. This is because of the dynamic and synergistic nature of human capital development which exhibits self-productivity and complementarity. Skills attained early in the life cycle facilitate the attainment of further skills later and also increase the productivity of later investments – as Carniero and Heckman put it "skill and ability beget future skill and ability" (2003, p.1). Studies of child development (Shonkoff & Phillips, 2000; Shore, 1997) emphasize that there are critical stages for the development of different types of abilities and that if the opportunity for the formation of these abilities is missed then attempts to rectify this at a later stage are problematic and expensive (Carniero & Heckman, 2003). Deficits in cognitive and non-cognitive skills emerge early as the result of differing inherited characteristics but crucially also differences in experiences in the home and early environments which affect the development of skills and the realisation of the potential of initial endowments. If uncorrected these deficits lead to low skilled adults with the opportunity for correction substantially reduced once the critical stages in childhood are passed. This implies that there is no trade-off between efficiency and equity when it comes to early investments whereas there may be for investments made at a later stage (Cunha *et al.*, 2005). It is noted however that investment later in childhood can still be productive and it is not the case that reaching a certain age represents a cut-off point after which skills cannot be developed – children show great resilience to recover from poor initial environments or the absence of positive experience (Waldfogel, 2007; Yaqub, 2002). However, as children age it becomes increasingly expensive to effectively remediate problems.

[5] Interventions providing pre-school education in the US, such as the Perry Pre-School Program, the Carolina Abecedarian Program, the Syracuse Pre-School Program and Head Start, have had a large degree of success in improving medium- to long-term outcomes for children from disadvantaged families; see Waldfogel, 1999; Currie, 2001, for excellent reviews of the benefits of such programs. In the UK, the EPPE project has demonstrated that pre-school is beneficial for the whole population and that disadvantaged children particularly benefit – see Melhuish, 2004.

[6] See the First National Childcare Strategy: www.surestart.gov.uk/_doc/0-BB628F.doc

In sum, there are strong theoretical arguments that investments made early in childhood are much more efficient than those made later in childhood and later in life, and these arguments are supported by numerous empirical studies.

3 Current Literature

There are several excellent reviews of early intervention programs that have been in operation in the US (see Blau & Currie, 2004; Carniero & Heckman, 2003; Melhuish, 2004; Waldfogel, 1999; Currie, 2001). Evaluating these various programs there has emerged something of a consensus that targeted interventions, and in particular small scale high-quality programs, are effective in producing short and medium-to-long term benefits in terms of scholastic success and later labour market outcomes, for disadvantaged children.

There have been fewer studies evaluating the effect of pre-school programs for the child population in general., and as it is my aim to look at both the effects on the more disadvantaged areas and the wider population, it is important to place my contribution in the context of the effect of pre-school education on all children as well as the disadvantaged in particular. A small number of cohort studies from the UK provide data rich enough to investigate the effect of pre-school experience on later outcomes and can shed some light on this area.

Jowett & Sylva (1986) using a small sample of working-class children who started school in September 1978, and controlling for child and family background characteristics, found that children attending nursery education performed better in primary school across a range of cognitive and non-cognitive dimensions than those who attended a playgroup.

The 1970 British Cohort Study collected a wide range of information on a sample of approximately 8,500 children born in one week of April 1970. Subsequently just over half of these children attended some sort of centre-based pre-school education, and these children were found to have higher cognitive attainment at ages 5 and 10 than those who had no pre-school experience, after controlling for socio-economic factors and maternal education (Osborn & Milbank, 1987). A positive effect was found for all types of pre-school settings compared to none, and there is a slight suggestion that nursery education had slightly greater benefits for disadvantaged children. However, Feinstein *et al*. (1998) have also analysed the British Cohort Study of 1970 and the 1958 National Child Development Study – which similarly follows a cohort of children born in Britain in one particular week in 1958. They find that while pre-school has a positive effect on cognitive abilities up to the age of 11, their analysis of the 1970 cohort suggests pre-school has a *negative* effect on vocabulary when the children were 5, and reading skills when the children were 11. Given the contrasting conclusions from these studies using the same data, it is with caution that we conclude the positive effect of nursery education on later child outcomes from this evidence.

More recently, Goodman & Sianasi (2005) have exploited the 1958 NCDS data and the longer time horizon to estimate the effect of pre-school experience on later child and adult outcomes. Using a sample of 12,500 children and after controlling for child, parent, family and neighbourhood characteristics, attending any pre-compulsory education (includes early school start as well as a pre-school centre) was found to have a positive effect on cognitive skills at age 7, which last through to age 16, though diminishing in size. Attending a nursery or playgroup in particular raised test scores, though this impact proved to be short-term.

While these UK studies provide some evidence of the effects of pre-school, it is difficult to extrapolate conclusions concerning the effects of attending a pre-school in the 1960s or even the 1970s to the present day, given changes over recent decades in educational practice and pedagogy, particularly in the early education sector.

To specifically investigate the impact of current pre-school experiences on young children's intellectual and social development, the UK Government launched the Effective Provision of Pre-School Education (EPPE) study in 1997. A sample of 3,000 children, from a range of social backgrounds, has been followed from the age of 3 and continues to be followed through their school careers. These children attended a range of different pre-school settings and there was also a sample (around one-tenth of the size of the main sample) of 'home' children who had no pre-school experience at all, in order to be able to estimate the effect of pre-school compared to none, as well as the effects of different types of setting. Multi-level modelling is used to evaluate the effects of different types of pre-school, controlling for background factors such as birth weight, gender, parental qualifications/occupations, home language and the home learning environment.

Briefly, the EPPE study finds that pre-school attendance by 3- and 4-year olds improves children's cognitive development and social behaviour on school entry, controlling for a rich set of background characteristics. Moreover, starting pre-school earlier is associated with positive intellectual gains, though there is no evidence that full day attendance had any greater impact than half day – the majority of children attended pre-school only half day. In terms of the additional effectiveness for disadvantaged children, the research suggests that pre-school can be an effective intervention for the reduction of special educational needs for the most disadvantaged and that high quality pre-school when aged 3 and 4 can improve reading skills and reduce prevalence of anti-social/worried behaviour. Whilst not claiming to eliminate initial disadvantages, pre-school can mitigate these effects and help children to start school on a more equal footing with their more advantaged peers (Sylva *et al.*, 2004).

It was also found that, controlling for background factors, the types of pre-school that are most effective at increasing intellectual and social outcomes, are nursery schools and classes and integrated centres – where there is care and education combined. While high quality can be found in all settings and types of provider, it was found that nursery schools and classes had the highest scores in terms of pre-school quality, while private day nurseries, playgroups and local authority centres had lower scores. This is important as there was a significant relationship between quality of the centre and improved outcomes for children (Sylva *et al.*, 2004).

Importantly, the time frame over which the EPPE study has been carried out fits almost exactly with that of data that I have constructed. Moreover, the EPPE study has subsequently looked at the performance of children at the end of Key Stage 1, when the children are 7 years old. The follow up at age 7 was designed to assess whether the effects of pre-school on development, evidenced at school entry, persist further into schooling such that there is a significant influence of pre-school experience on performance in national assessments at the end of Key Stage 1 – after the children have spent at least two full years in primary school (see figure 1).

Figure 1: Key Stages of Compulsory Schooling in England

Year Group	Reception	1	2	3	4	5	6	7	8	9	10	11
Age of pupils at end of year	5	6	7	8	9	10	11	12	13	14	15	16
Key Stage	Foundation Stage	KEY STAGE 1		KEY STAGE 2				KEY STAGE 3			KEY STAGE 4	

The EPPE results show that attending a pre-school centre compared with none, continues to be associated with significantly higher attainment levels in reading and mathematics, controlling for child, family and home learning environment effects (Sammons *et al.*, 2004) – so the 'home' group have not caught up with their peers who did attend pre-school. The strongest relationship is with reading attainment, though maths attainment is also significantly higher – so the effect that is clear upon school entry has not 'washed out' by the end of KS1. While it has been reduced somewhat, there remains a significant attainment gap between those that do and those that do not attend pre-school after controlling for relevant background

factors. It is not possible to fully disentangle the effects of duration, quality and effectiveness of pre-school attended in comparison with the 'home' group; however the findings show that these factors remain predictors of better cognitive attainment at KS1. *Within* the group of children who did attend pre-school, there is no longer a significant effect of longer duration or higher quality on outcomes at the end of KS1, however measures of the effectiveness of a pre-school centre at promoting cognitive progress continued to show a significant positive impact on attainments at KS1, which suggests that while the greatest differences are between those that had pre-school experience and those that did not, the nursery school and integrated settings continue to have the greater positive effect. Importantly, it is found that while the overall effect is similar across all socio-economic groups, there is a particular benefit of pre-school for disadvantaged children in that it raises them above the minimum expected levels at KS1, which means that on average, these disadvantaged children begin KS2 at a level that allows them to access the KS2 curriculum (Sammons *et al.*, 2004).

The government should be concerned about results at KS1 due to the links between early school performance and later scholastic and labour market attainments as witnessed in many US and UK studies. Moreover, Currie & Thomas (1999) cite cogent evidence that cognitive outcomes at age 7 are a strong predictor of a range of later outcomes including school qualifications, employment and earnings. In the UK, Feinstein (2000) demonstrates the predictive power of early attainment for later academic achievement. Looking specifically at KS1 results, Sammons *et al.* (1995) show that performance at this level is a good predictor of success at GCSE, the key high school qualifications that play a large role in determining the post-compulsory schooling destination of young people in the UK.

My contribution is to estimate the effect of the introduction of free early education places for all 3-year olds, at the aggregate level of the Local Education Authority – as the policy was implemented at the level of the LEA, it makes sense to evaluate the policy effects at this level. Local Education Authorities are the bodies responsible for the local administration of state sector education in England, and so it is important to examine how changing the education provision in LEAs over time affects overall results within these areas. If universal provision of free early education from age 3 is as effective as is suggested by the literature, we should see lasting positive effects of the policy. As I have the KS1 results from 2001-2006 for each LEA and given that the policy was introduced at two time points, depending on the level of deprivation in the LEA, this provides an identification strategy for evaluating whether the policy has had an effect on KS1 results.

Moreover, since for each LEA I have the take-up of places in both the maintained nursery and primary schools and in the 'other' sector– comprising private, voluntary and independent providers and a small number of maintained settings other than nursery and primary schools – and given that the policy worked through utilising 'other' sector provision of early education places, I can evaluate whether the increase in take-up in what is essentially the private sector, has had any effect on subsequent results at KS1. As detailed above, these KS1 reading, writing and maths tests, taken at age 7, are the first standard national assessments that children take after starting school and thus provide a useful benchmark.

Furthermore, I can address the question of whether there was greater benefit for the LEAs deemed to be in greatest need of the provision i.e. the ones that were given the funding first. However, allowing the policy effect to differ between these two groups of LEAs weakens the identification strategy as I can no longer fully exploit the difference in timing of the policy's introduction to identify the policy effect. When looking at the simplest model with just separate dummies for the introduction of the policy in the poorer and better off LEAs, the identification comes from the assumption of common year effects but separate policy effects that are constant within type of LEA over time. In the model allowing for different effects of the actual levels of take-up in the 'poorer' and 'better off' LEAs, the identification is based on the fact that this is a policy change, from zero places provided for free in the 'other' sector to a positive and increasing number being provided and taken up. As the places for 3-year olds are provided for free, the take-up of these places in each setting should not be driven by income which is correlated with characteristics of the children and also therefore with outcomes. To the extent that all budget constraints are affected, the effect

of this policy change provides estimates of the effects of free early education in each sector on results. Again it is necessary to assume common year effects so that the effects of differences in take-up variables can be identified.

Differing effects depending on which setting provides an early education place has implications for the way in which the Government should provide early years education – whether through expansion of capacity in state maintained school settings or by continuing to fund provision through the 'other' sector.

The advantage of having area level data is that it has been possible for me to build a panel of LEA inputs and results, and look at repeated measures of the KS1 assessments for each LEA, controlling for the fixed characteristics of each LEA, and evaluate the effect of altering the early education input. Analysis at the level of each individual child does not permit a panel to be created which would allow the fixed characteristics of the child and his/her family to be controlled, rather relying on richness of controls to capture heterogeneity – which may or may not be deemed sufficient. Therefore it is an advantage to have LEA level data allowing a panel to be created to control for unobserved factors and analyse the effects of this change in policy implemented at the LEA level. The data that I have also has the advantage of delineating clearly the places provided by maintained nursery and primary schools and those provided in other settings, allowing an explicit contrasting of these two provider types. Moreover, the data covers LEAs across the length and breadth of England over more than half a decade, which will help to add to the picture of early education and its effectiveness across England during this time.

4.1 Background to the Free Early Education Places policy

The Government has a broad agenda aimed at breaking cycles of poverty and social exclusion, and a well-publicised target of cutting child poverty in half by 2010 and eradicating it within a generation[7]. A cornerstone of the Government's strategy is helping people to break free from reliance on benefits and move into work – particularly lone parents. The strategy operates on several levels, one of which is motivated by the reality that access to affordable, high quality childcare – or rather lack of access – is a factor that can restrict employment opportunities, particularly for the poorest families, and especially single-parent families.

Chevalier & Viitanen (2001) suggest that a lack of childcare was blocking maternal employment in the UK in the mid-1990s and estimate that supply was pretty inelastic with demand outstripping supply by more than 50%[8]. This implies that the provision of good quality, affordable childcare by the Government, would reduce this queue, allowing mothers to return to work. The Government has responded to this and one part of their national childcare strategy is to ensure that there is high quality, affordable childcare for all children aged 0-14 in every community. Moreover, given the innate substitutability between childcare and early education places, this provides an additional motivation – on top of the potential positive effects on children's attainments – for the Government to be involved in providing free early education places. This is even more so the case in the disadvantaged communities in which there had been a lower supply of childcare and nursery places due to the risks to private providers in setting up in these areas and, on the demand side, financial constraints on poor parents making them unable to purchase the optimal levels of childcare and/or nursery for their children. For this reason the Government has specifically targeted several other initiatives at the poorest 20% of wards – through Early Excellence Centres, Sure Start Local Programmes and the Neighbourhood Nurseries Initiative[9]. As well as these supply side interventions,

[7] This pledge was given by the then Prime Minister, Tony Blair, in March 1999.

[8] See also reports by the Daycare Trust into lack of childcare availability: "The childcare gap: Briefing Paper 1." London: Daycare Trust, 1997; "Delivering the National Childcare Strategy: Briefing Paper No.1." London: Daycare Trust, 1999. The First National Childcare Strategy (www.surestart.gov.uk/_doc/0-BB628F.doc) also makes reference to the unmet demand for childcare, stating that 4 out of 5 non-working mothers would work if they could access the childcare of their choice (p. 14).

[9] 29 Early Excellence Centres were piloted in 1997 with 2/3 of them in the poorest 20% of population wards; subsequently rolled out to a total of 107 centres. Sure Start Local Programmes were introduced in 1999 in the poorest

there has been an increase in financial assistance to pay for childcare, via the childcare tax credit. These initiatives work in parallel with the expansion of early education places in order to improve outcomes for children and their parents.

4.2 Historical Context

Before 1997, the law did not oblige LEAs to make educational provision for children under compulsory school age, and the decision of whether to provide free nursery education, and if so how much to provide, was left to each individual LEA – leading to substantial variation in provision. According to Brewer *et al.* (2005) across the country provision ranged from zero free pre-compulsory education places provided, to a high of 27.5 places per 100 children in 1986. This variation in access to nursery education according to postcode and income persisted into the 1990s.

In an attempt to create a market for nursery education, the Conservative government introduced a nursery voucher scheme in April 1997, which entitled all parents of 4-year olds to a voucher worth £1,100 to purchase nursery provision for their child from either a maintained, private or voluntary organisation. The theory was that allowing parents to choose the best place to send their child would raise quality through competitive forces.

In May 1997 the new Labour government were elected and whilst initially they continued the roll-out of the piloted voucher scheme, they had a manifesto commitment to scrap the vouchers on the basis that they were costly and did not generate quality nursery places[10]. The nursery education voucher scheme was replaced by a local structure of Early Years Development and Childcare Partnerships and Plans, detailing how each LEA would provide sufficient early education places for children of the prescribed age within their area, whether this was supplied by the LEA itself (i.e. maintained places) or not. Initially the prescribed age was 4 years old but there were plans already to extend the scheme to include 3-year olds.

The first National Childcare Strategy was launched in May 1998, part of which involved the immediate mandatory introduction of free part-time early education places for all 4-year olds whose parents request one and also established that this would be extended to cover all 3-year olds, phased in according to the level of deprivation of the LEA. The 65 most deprived LEAs in England would extend the free early education places to 3-year olds in 1999-2000, while for the remaining 85 LEAs the extension to 3-year olds would not occur until 2000-2001[11]. Prior to 1999, any LEA could provide free early education places for 3-year olds as long as they had capacity in their maintained nursery and primary schools. However, in order to meet the commitment of places for **all** 3-year olds whose parents wanted a place, the private sector needed to be utilised. To pay for nursery education places supplied by providers other than the LEA itself, the Nursery Education Grant (NEG) was already available for places for 4-year olds from 1998. In tandem with the roll out of free places for 3-year olds, from 1999-2000 the NEG was available for 3-year olds' places in the 65 poorest LEAs and in the following year in the remaining 85 LEAs. Originally the target was to have a free place available for all 3-year olds by September 2004, though this was actually achieved by April 2004. When introduced in 1998-1999 the NEG was a maximum per child per year of £1,100. This rose each year so that it was £1,221 per child per year for 2002-2003.

For the period of my data, the funding for free early education places was paid directly to providers (maintained and non-maintained) by central Government[12]. Therefore, it is not the case that there is a

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20% of population wards, by 2002 there were 260 and by 2004 there were 524. The Neighbourhood Nurseries Initiative introduced in 2001 aimed to provide quality childcare places in the 20% most deprived wards in England.

[10] The Labour Party Manifesto, 1997. The alleged costliness was due to vouchers being given to the parents directly which entailed high administration costs.

[11] See the National Childcare Strategy: www.surestart.gov.uk/_doc/0-BB628F.doc.

[12] Since April 2003 this has changed such that early education funding has been provided to LEAs by central Government via the formula spending share.

potential trade-off between spending on under-5s and spending on over-5s within the LEA – LEAs could not choose to focus funds on one at the expense of the other, thus there should not be a problem of the estimated effect of increased early education provision being mitigated by reduced primary spending.

There is currently a pilot scheme looking at extending the free early education places to cover 12,000 two-year olds living in the most disadvantaged communities[13] – hence it is pertinent to ask whether the extension of provision to 3-year olds in having a measurable effect on test results.

4.3 What is a Free Early Education Place and Where Can One Be Taken?

A free early education place consists of five sessions of early education per week, each session lasting a minimum of two-and-a-half hours (i.e. a morning or an afternoon), for 33 weeks of the year. All settings providing free early education places must be working towards Early Learning Goals and other features of the Foundation Stage Curriculum – which is the first stage of the National Curriculum focusing on the needs of 3- to 5-year olds and implemented primarily through planned play activities designed to develop children's emotional, physical, social and intellectual capabilities. Places are usually delivered in three 11-week terms – based on the terms of nursery schools and classes in the maintained sector.

Maintained sector providers of free early education places are funded and run by the local authority and are either: nursery schools and nursery classes, infant classes in primary schools, day nurseries, Children's Centres/Family Centres or other local authority providers such as Special Schools. Within the maintained sector, the vast majority of free early education places are provided in nursery schools and nursery or infant classes of primary schools, and children are not usually admitted before their third birthday.

In the non-maintained sector, early education places are provided by voluntary, private or independent bodies or by groups of parents, in a variety of settings such as non-maintained nursery schools, private nurseries, playgroups, childminders, or nursery classes attached to independent schools. These non-maintained sector providers must be registered with the LEA and named as partner in the Early Years Development and Childcare Partnership.

In order to be a named Partner, each setting must meet 14 national standards verified by an inspection by the Office for Standards in Education (Ofsted). The national standards specify that childminders can look after no more than 6 children under the age of 8; no more than 3 of which can be under the age of 5, and of these 3 no more than 1 may be under 1 year old. Private nurseries and playgroups must have a manager with a specified level of qualifications and number of years experience, as must all of the employees of the facility. Moreover a group can never exceed 26 children and there must be at least two adults on duty at any time. The staff-child ratio that must be adhered to for children in the pre-school age bracket is a minimum of 1:8. Maintained Children's Centres and Family Centres also have to meet these national standards.

Maintained nursery and primary schools are also inspected by Ofsted and required to meet certain recommended standards, ensuring that there is a minimum of 2 members of staff for every 26 children in a nursery class in a maintained nursery or primary school[14]. One member of staff must be a qualified teacher and the other a qualified nursery assistant. These requirements are also imposed on private nursery schools and nursery classes attached to independent schools.

So while all settings aim to deliver the same Foundation Stage Curriculum, they essentially represent different technologies for this delivery. Pre-school education had been provided by non-nursery/primary school settings prior to the introduction of the free early education place policy, however it is only since

[13] Detailed in the Government Spending Review, 2004.
[14] The minimum is 2 members of staff for every 20 children if the main teacher has other administrative duties (i.e. is also the head teacher).

the advent of this policy in 1999-2000/2000-2001 that these early education places with their structured and regulated form and their own curriculum and teaching requirements, have existed outside the maintained schools system.

The question is whether the increased NEG payment from the Government, allowing 3-year olds to access early education in these non-school settings, has had any effect on children's results? Would a better strategy be to increase the capacity of maintained schools rather than effectively contracting out the commitment to provide early education? And does the answer depend on the prosperity of the LEA?

5.1 The model – initial policy evaluation

In evaluating whether the policy of allowing free early education places for all 3-year olds has had an effect on results, the first basic model to look at is a simple linear panel regression model with fixed effects at the level of the LEA, and with just a simple [0,1] dummy to indicate the years in which the policy is in operation:

$$R^{s}_{jt+3} = \beta_0 + \beta_1 policy_{jt} + \mathbf{T}'_t\alpha + c_j + e_{jt+3}$$

where R^{s}_{jt+3} are the results outcomes: the percentage of children in LEA *j* at time *t+3* who attain a specified level in subject *s*, where $s \in$ {reading, writing, maths}. The levels that I look at are L2B or higher, which is the level that children are expected to attain at KS1, and L3 or higher which represents very high achievement at KS1;

$policy_{jt}$ is the [0,1] dummy to indicate that the policy is in operation in LEA *j* at time *t*;

$\mathbf{T}_t$ is a vector of year dummies; c_j is the fixed effect for LEA *j*; and e_{jt+3} is the idiosyncratic error term for LEA *j* at time *t+3*.

It is necessary to estimate the model using the fixed effects estimator due to the nature of selection into the group of LEAs that have the policy implemented in the first phase. As outlined above, it was the 'poorer' LEAs, the 65 deemed to be in greatest deprivation, that were given the Nursery Education Grant to pay for early education places for all 3-year olds in 1999-2000, while the 'better off' LEAs did not receive the funding until 2000-2001. In the notation, the 'poorer' LEAs who were the first to receive the policy funding are referred to as the 'first 65' or f65 LEAs, while the 'better off' LEAs are referred to as 'not first 65 LEAs' or nf65. As well as being the first to have the policy implemented, these 'poorer' LEAs also have a results distribution which is lower than the distribution for the 'better off' LEAs. Consequently, in a cross sectional estimate of the effect of policy on results, we will pick up some of the negative effect of being a poorer LEA through the coefficient on the policy dummy – there is a correlation between the fixed unobserved component of the error term and the policy dummy, biasing the coefficient downwards.

Implementing a fixed effects regression controls for all of the time invariant characteristics of the LEA, treating the unobserved component of the error term for each LEA as a parameter to be estimated and therefore allowing a clean estimate of the policy effect. The selection issue is dealt with by the fixed effect specification since selection into the early treatment group is on the basis of fixed unobservable characteristics that are subsumed in the fixed effect and thus controlled for. The policy effect is identified through differences between LEAs in their within variation in policy status and results.

Included in the model are a set of year dummies with the first results year the omitted comparison year in each case. It is necessary to include year dummies to take account of any common trends in results due to the year of the test – though the assessments are standard across the country, there may be countrywide cohort effects or marking leniency changes that equally effect all LEAs in the different years. As the policy is implemented at a different time for two different groups of LEAs there is not a problem of the year dummies and the policy dummy being collinear. It is necessary, however, to assume that the year

effects are common across the two groups of LEAs in order for this identification strategy to be successful. I believe that this is a reasonable assumption given that there should be no reason why the year effects would not be common to all LEAs if they are driven by variations in marking standards, since the assessments are marked to an externally implemented national criteria that is standard across the country. Moreover there is no reason *a priori* to assume that there are differing cohort effects depending on whether an LEA is in the 'first 65' group or not.

As I also wish to look at the extent to which the policy has affected the areas of most concern i.e. the LEAs that were deemed most in need of the policy and therefore had the policy implemented first, I also estimate the policy evaluation regressions allowing for a different policy effect depending on whether the LEAs were the poorer 'first 65' or the better off 'not first 65' LEAs:

$$R^s_{jt+3} = \beta_0 + \beta_1 policy\_f65_{jt} + \beta_2 policy\_nf65_{jt} + \mathbf{T}'_t\alpha + c_j + e_{jt+3}$$

where all variables are as per their definitions above, and with $policy\_f65_{jt}$ the policy effect for the poorer LEAs and $policy\_nf65_{jt}$ the policy effect for the better off LEAs. Clearly this weakens the identification strategy as I can no longer fully exploit the difference in timing of the policy's introduction between the two groups of LEAs. The assumption of common year effects means however that I can identify separate policy effects for the two groups of LEAs without them being collinear with the year dummies.

Whether estimated separately or in single policy dummy variable, it is also necessary to assume that the policy effect is an intercept shift that is constant in each year that the policy is in operation – otherwise it is clear that some of the policy effect in the later years, when all LEAs have the policy in operation, could be subsumed in the year dummies thus we could not delineate the separate policy effect were we not to assume it to be constant and identified through the years when the policy dummies are not equal to each other.

5.2 A more detailed look at the policy implementation

In addition to looking at the basic model assessing the policy effect by looking at results before and after the policy implementation, I also implement a more sophisticated approach in order to try and understand the channels through which the policy may be working. While the policy itself specifies that all 3-year old children are entitled to a free early education place provided by the LEA either in a maintained school setting, another maintained setting, or fund with another provider, it is the case that 3-year olds could attend maintained school settings and receive an early education place prior to the policy introduction, if the LEAs had the capacity. Therefore it is necessary to control for the take-up of places in the maintained nursery and primary schools both before and after the policy implementation.

As discussed above, the expansion of free early education places for 3-year olds, since 1999-2000, has essentially been in the private sector as 4-year olds account for much of the maintained sector capacity. However, all children are entitled to an early education place when they are 4 years old also. Since the introduction of the policy for 3-year olds was a shock to the whole pre-compulsory education market – for 4-year olds as well as 3-year olds – the effects may work through a number of avenues which need to be considered in the model. Therefore rather than looking at what happens when these children are 3-year olds in isolation, I look at what is happening at each age, within the same structure: I include the take-up rate of early education places by 3-year olds in an LEA and the take-up rate of early education places by 4-year olds in the same LEA the following year i.e. when these same 3-year olds are 4 years old. The effects of changes in these take-up rates on results in KS1 tests two years later – when these children are assessed at the end of Year 2 – is estimated.

The main question that the model asks then is: controlling for the take-up in each sector of free early education by 4-year olds, what is the effect on KS1 assessments, of introducing free early education places for these children when they were 3 years old?

The model is again a linear panel regression with fixed effects at the level of the LEA:

$$R^s_{jt+3} = \beta_0 + \beta_1 NPS3_{jt} + \beta_2 non3_{jt} + \beta_3 NPS4_{jt+1} + \beta_4 non4_{jt+1} + \mathbf{CC}_{jt}'\delta + \mathbf{X}_{jt+3}'\gamma + \mathbf{Z}_{jt}'\varphi + \mathbf{T}_t'\alpha + c_j + e_{jt+3}$$

again R^s_{jt+3} are the results outcomes: the percentage of children in LEA *j* at time *t+3* who attain a specified level (2B or 3) or higher in subject *s*, where $s \in$ {reading, writing, maths};
$NPS3_{jt}$ is the percentage of the 3-year old population in LEA *j* at time *t,* taking a free early education place in a maintained nursery school or a nursery class in a maintained primary school;
$non3_{jt}$ is the percentage of the 3-year old population in LEA *j* at time *t,* taking a free place with a private, voluntary or independent provider or in a non-school maintained setting[15];
$NPS4_{jt+1}$ is the percentage of the 4-year old population in LEA *j* at time *t+1,* taking a free early education place in a maintained nursery school or nursery/infant/reception class in a maintained primary school;
$non4_{jt+1}$ is the percentage of the 4-year old population in LEA *j* at time *t+1,* taking a free place with a private, voluntary or independent provider or in a non-school maintained setting[16].
$\mathbf{CC}_{jt}'$ captures the availability of childcare places generally in the market in LEA *j* and time *t* i.e. at the time that the children are 3 years old and can redeem their free early education place. $\mathbf{CC}_{jt}$ is $\begin{bmatrix} dnp_{jt} \\ cmp_{jt} \\ pgp_{jt} \end{bmatrix}$,

where dnp_{jt} is the number of available places in day nursery per 100 children aged 3 or 4 in LEA *j* at time *t*. cmp_{jt} and pgp_{jt} are similarly defined for childminder places and playgroup places respectively.
$\mathbf{X}_{jt+3}$ is a vector of the characteristics of schools in LEA *j* at time *t+3*, such as the average KS1 class size and the ethnic composition of schools. As before, $\mathbf{T}_t$ is a vector of year dummies; c_j is the fixed effect for LEA *j*; and e_{jt+3} is the idiosyncratic error term for LEA *j* at time *t+3*.

As each of the take-up rate variables is defined as the proportion of the population of the relevant age in the LEA taking their free early education place in that setting, the omitted category are the children who do not take a free early education place. The interpretation of these coefficients is therefore the effect of increasing the take-up rate in a particular setting compared to not taking up a free early education place in any setting.

We know from looking at the data itself and from previous research (see Brewer *et al.*, 2004; Melhuish, 2004) that LEAs have different characteristics – in terms of demographic composition, class and socio-economic status (SES) mix, employment, education. These differing characteristics have had an effect through time to alter the levels of provision of early education and childcare services within each LEA, so different areas start the panel with different initial endowments. Moreover, while it is possible to some extent to control for observable differences between the LEAs, there may be unobserved characteristics of

[15] As outlined, this 'other' sector includes some maintained settings other than nursery schools/classes but it is essentially private, voluntary or independent provision.
[16] See previous footnote.

the LEA that are correlated with both the take-up rate of early education places in each sector, and the results in KS1 assessments. For example, it may be that an LEA has a high proportion of high SES families and that these families put a strong emphasis on education. We would expect that take-up of early education places in this LEA would be high, and that independent of early education, KS1 results would also be higher given the parental attitude towards the education of their children. In a cross sectional estimate this would result in an upward bias in the estimated coefficient on early education place take-up.

As we know that the balance between take-up in public and private settings, and the take-up rates themselves, differ between LEAs according to observed characteristics, and we expect that this is also the case for unobserved characteristics such as attitudes and tastes, we cannot make inferences of causal effects from cross-sectional estimates because of the bias resulting from these confounding unobserved characteristics. Estimates using the between estimator, find that having high levels of childcare provision – particularly playgroups and childminders – and lower levels of maintained sector place take-up is associated with higher assessment results. However it is clear that this is picking up the correlation between unobserved characteristics of the LEAs (such as socio-economic status mix) that influence both the number of childcare places available, the take-up in the maintained sector and also the KS1 results. In addition, the between estimates show that having high levels of take-up by 3-year olds in the 'other' sector is associated with lower results, though again as we know that the time-average take-up in the 'other' sector is higher for the poorer LEAs because they have the funding for these places before the better off LEAs, the significant negative effect on results is capturing the correlation between the unobserved characteristics that lead to this higher average take-up and also lead to lower average KS1 results[17].

Implementing the model as a fixed effects regression means that we lose the information from the cross-sectional variation in take-up; however, Hausman tests on the correlation between the fixed unobserved component of the error term and the regressors provide evidence supporting the prior that there is correlation between these time-invariant unobserved characteristics of the LEA and the regressors.

By implementing the model as a fixed effects regression, we circumvent this problem of bias owing to the correlation between the fixed unobserved factors – that we suspect are correlated with the outcomes – and the regressors in the model. All of the time-invariant characteristics of the LEA that may cause a bias in estimates, plus factors such as the size of and number of schools and the quality of teaching will be subsumed in the fixed effect – to the extent that these factors are constant throughout the time-span of the panel. Given that the panel is quite short – spanning 6 years – it is reasonable to assume that the class/SES mix of the LEA remains stable over the time of the panel. Similarly, I do not believe it too heroic an assumption to make, that the average quality of teaching within the entire LEA's schools remains approximately constant throughout the time of the panel.

As detailed above, the fact that the policy was introduced at two different time points provides additional variation in the key explanatory variable – the take up rate of early education places in the 'other' sector. Moreover, key to the identification strategy is the fact that changes in take-up of early education places by 3-year olds in this sector are theoretically exogenous to income. While previously attempting to quantify the effect of, for example, private sector nursery attendance on outcomes was undermined by the differential use of these settings according to their costs, the fact that the policy change allows private places to be taken by **any** 3-year old child and paid for by the Government, means that the use of early education places in each setting is theoretically no longer affected by budget constraints.

In terms of identification, the fixed effect deals with between LEA differences in take-up rates that are correlated with time-invariant unobserved characteristics that are also correlated with results. Within each LEA, the identifying assumption has to be that changes in take-up rates in each sector are exogenous – i.e. implying that they are random between the maintained school settings and the 'other' sector settings. As

[17] Details of the between estimator results and the Hausam test results (see next paragraph) can be obtained on request from the author.

this may not be the case there is a selection issue: the coefficient on the take-up rate in each sector may be biased up or down by picking up the effect not of the setting itself but of the characteristics of the type of children attending that setting. However, to the extent that the key selection mechanism is income, this selection issue is dealt with – there is no cost of these places in either type of setting and therefore there is no selection according to which families can afford to pay for private places. Arguably it may continue to be the case that, within an LEA, changes in the take-up in the two sectors continues to differ according to tastes that are correlated with income; nevertheless income itself as a direct confounding factor has been removed. Moreover, it is not clear how this selection would work – would better off parents send their children to private settings or, would they be more likely to use the maintained school setting, in the knowledge that they are inspected and rated highly as early education providers? Similarly would poorer parents look to use the private settings that were previously unavailable to them or choose maintained school settings? Therefore I believe it reasonable to assume that changes in each sector within an LEA are exogenous – that the shock of the policy introduction did not lead to differential take-up across the sectors according to characteristics that are also correlated with results, and therefore I can obtain unbiased estimates of the effect of changes in take-up in each sector on KS1 results.

The fixed effect estimated for each LEA accounts for time-invariant heterogeneity at the LEA level, and as before, the time-dummies included in the model will account for any common time variation that affects results. There may still be time-varying heterogeneity at the level of the LEA that could bias estimates. However, it is difficult to imagine what this time-varying unobserved heterogeneity could be. Almost by definition, anything that is a distinct characteristic of an LEA must be reasonably time-invariant in order to be a recognised feature of the LEA – as opposed to some random variation. Therefore the LEA level fixed effects included in the estimation should do a good job of accounting for differences between the LEAs, and allow me to estimate the effect that 'other' sector free early education places have on outcomes, purged of the effects of heterogeneity between the LEAs that is correlated with the take-up rates and the outcomes.

There is a problem with the identification of the effect of the increased 'other' sector take-up by 3-year olds, in that, as the initial take-up is zero in all LEAs but increasing year-by-year as the policy is implemented, this inevitably reduces the variation *between* LEAs in terms of their *within* variation in this variable. However, the fact that the policy was introduced at two different time points adds to the variation in this variable and strengthens the identification strategy.

Furthermore, there is also inevitably a strong correlation between this take-up rate and the year dummies. However, since we have the take-up rate of 'other' sector places in this more complex model, as opposed to just [0,1] policy dummy, means that there is more local variation to exploit for identification, over and above just the switching on of a policy dummy.

The error term for each observation, u_{jt+3}, is comprised of c_j and e_{jt+3}. The fixed effect c_j contains the non-time varying characteristics of the LEA, therefore implementing a fixed effects regression will reduce the correlation between the error terms of the LEAs as it controls for the presence of the c_j. However there may still be some correlation in the errors of observations from the same LEA (i.e. some correlation between the e_{jt+3} parts of the error for observations from the same LEA) thus clustering at the level of the LEA is necessary. The clustering allows the idiosyncratic errors for an LEA to be correlated over time but the idiosyncratic errors across LEAs are assumed independent. Moreover, clustering automatically provides the robust standard errors that allow for heteroskedasticity in the error terms. Importantly, the estimates of the standard errors do not assume a specific functional form for the within LEA correlation or heteroskedasticity.

Given that the LEAs first to receive the NEG for 3-year olds have higher levels of deprivation and lower educational attainment outcomes, we would expect – and the Government hopes – that increasing take-up of free early education places in the poorer LEAs would have a greater effect than in the more prosperous areas. In the second specification of this more complex model, I am again interested in looking at whether

this proves to be the case – whether there are differing effects dependent on whether or not the LEA is one of the 65 the Government identified as having higher levels of deprivation. Therefore, I re-estimate the following specification of the model:

$$R^{s}_{jt+3} = \beta_0 + \beta_1^{nf65} NPS3\_nf65_{jt} + \beta_1^{f65} NPS3\_f65_{jt} + \beta_2^{nf65} non3\_nf65_{jt} + \beta_2^{f65} non3\_f65_{jt}$$
$$+ \beta_3^{nf65} NPS4\_nf65_{jt+1} + \beta_3^{f65} NPS4\_f65_{jt+1} + \beta_4^{nf65} non4\_nf65_{jt+1} + \beta_4^{f65} non4\_f65_{jt+1}$$
$$+ \mathbf{CC}_{jt}'\delta + \mathbf{X}_{jt+3}'\gamma + \mathbf{Z}_{jt}'\varphi + \mathbf{T}_t'\alpha + c_j + e_{jt+3}$$

All variables are as defined above, and in addition $\mathbf{Z}_{jt}$ is a vector of characteristics of LEA *j* at time *t*, capturing the deprivation level of the LEA at the time that the children were 3 years old – elements include the male economic inactivity rate, the male average weekly pay rate, and the manufacturing jobs rate.

The other difference from the earlier specification is that the slope coefficients on the take-up rate of places in each sector and at each age, are allowed to differ according to whether the LEA was one of the 'poorer' first 65 LEAs to receive the NEG (subscript _f65) or not (subscript _nf65). Clearly the allocation into these two separate groups was not random, it was on the basis of the characteristics (deprivation level) of the LEAs, which may be varying to some extent over time. Therefore it is important that I control for this as far as possible in the model – or else the estimated coefficients could be biased through picking up effects of being (non-)deprived on the KS1 results. The fact of being one of the poorest LEAs in 1998 – when the decision was made over which LEAs would receive the funding first – is a fixed characteristic and therefore part of the fixed effect and thus not a problem. That the groups of LEAs are different in terms of deprivation would not bias their coefficients as long as deprivation is just a fixed characteristic of the LEA that does not change during the time period of the panel. However as this is not the case – deprivation has different dimensions that are variable – this may introduce a bias. It could be that in the poor LEAs certain characteristics change over time in a different way to the changes in these characteristics in the more prosperous LEAs. If this is the case, then we would worry that it is the changes in these other variables that are influencing the outcomes and therefore would be biasing the coefficient on the 'other' sector take-up rate which we know ***is*** changing differentially according to the deprivation level of the LEA. Therefore in order to control for characteristics correlated with deprivation, which determined allocation to the 'first 65' group, I include in the vector $\mathbf{Z}_{jt}$ time-varying features of the LEA that can indicate levels of disadvantage. This should prevent the coefficients on the take-up rate variables in each group being biased by the influence of these other time-varying factors correlated with deprivation level.

As outlined above, the identification strategy is weakened when looking at separate effects of changing take-up of places by 3-year olds in the 'other' sector, since I can no longer exploit the variation owing to the 'first 65' group of poorer LEAs having the policy implemented a year before the remaining 85 LEAs. However, the change in policy itself – from zero places in the 'other' settings being funded to a positive and increasing amount being funded by the Government – is still a change that is exogenous to parents' income in each group of LEAs and should therefore be able to provide identification of the causal effect of these free early education places on later outcomes. I continue to assume that any year effects on results are common across all LEAs, and therefore the separate effect of take-up in each of the different groups can be identified as distinct from the year dummy effects. Again the fact that there is more local variation in the take-up variables than in the year dummies improves the identification strategy.

It is noted that while I can answer the question of whether the increased funding for early education places for 3-year olds had any positive (or negative) effects on children's KS1 performances, there are a number of things that I am unable to answer. For example, it is not possible to distinguish between a zero effect, and an effect that is 'washed out' by the end of Year 2. However, in some respects this does not matter in

that, if there is an initial effect but it washes out after two years of schooling, then there is really no effect – no lasting effect in any case, and it is effects that last into middle-childhood and beyond that are of concern.

In assessing the success of the policy, I am focusing narrowly on any effects on KS1 results, however, there are other positive effects of early education on social, behavioural and emotional outcomes that are not captured in KS1 results[18] which are increasingly being recognised as of great importance in terms of scholastic and later success in the labour market and society in general (see Carneiro and Heckman, 2003; Melhuish, 2004; Waldfogel, 2007). Moreover, there are potentially very large benefits, in terms of child outcomes, parental outcomes and societal outcomes, if the policy facilitated the return to work of parents, particularly lone-parents. Thus I am not attempting to formally quantify the costs and benefits of the policy, I am focused narrowly on the effectiveness of this policy in terms of improving early educational attainment as measured by Key Stage 1 results.

6.1 Data

The dataset that I use to estimate the model has been constructed using data from a number of sources. The primary sources of data are the Department for Education and Skills (DfES) who provide information on the number of free early education places taken, by age, for each sector in each LEA in January each year; and National Statistics who provide data on the population, by age, in each LEA in January each year. Using these two sources I have constructed the take-up rates of free early education places separately for 3-year olds and 4-year olds in each LEA in January each year. The first year of data is for children who were 3-years old in January 1998, and I have the information annually until January 2003 – creating a panel that spans 6 years. There is a gap in 2002 as childcare data was not collected in that year, hence it is a 5- rather than 6-year panel, 1998-2001 plus 2003.

The DfES also provides the information on the number of childcare places available in the different childcare settings – day nursery, playgroups and childminders – in each LEA in each year[19]. As I am interested primarily in the effect of the expansion of funded places for 3-year olds, I am interested in the childcare market in each LEA at the time that children are 3 years old. However, since there are 4-year old children in this market also demanding childcare places, I estimate the number of places available relative to the size of the population aged 3 **or** 4 at the time the cohort in question are aged 3 – in recognition of the fact that these childcare places are not just for 3-year olds.

The DfES also provides information on the characteristics of maintained schools in each LEA[20], allowing controls to be added for the effects of average class size for KS1 classes, and the ethnicity of pupils in maintained primary schools in the LEA – which I use to construct the percentage of non-white children in each LEA's maintained primary schools.

Using data from the Labour Force Survey (LFS)[21] I construct variables to attempt to control for the level of deprivation in the LEA. Using the LFS local area data for the relevant quarter, I construct for each LEA various measures of the local economic structure and prosperity such as the economic inactivity amongst working age males, the unemployment rate amongst working age males, the unemployment rate and economic inactivity rate for 16-24-year olds, the professional occupations rate, and the manufacturing

[18] To the extent that behavioural improvements facilitate learning there will be some capture of these effects though not explicitly.
[19] The DfES childcare data is for March each year, thus is slightly after the free early education place data, though it is fair to assume that the availability of childcare places in March is a good approximation to the position in January.
[20] Available at http://www.dfes.gov.uk/rsgateway/DB/VOL/index.shtml in the annual Statistics of Education: Schools in England, LEA level included publications.
[21] Provided by the Data Archive, under project number: 18375.

occupations rate. From the Annual Survey of Hours and Earnings[22] I also construct the following median pay measures for full-time male workers: gross weekly pay, weekly pay excluding overtime, weekly pay basic, gross hourly pay, and hourly pay excluding overtime, for each LEA in each year that I look at data for 3-year olds. All of the independent variables data is annual for the years 1998 to 2001 plus 2003.

The dependent variables data also comes from the DfES, who publish the results of national Key Stage 1 standard assessments[23]. For each of the results years 2001-2006, the DfES publish the percentage of children in each LEA's maintained schools attaining various levels in their KS1 assessments of reading, writing and mathematics. As mentioned above, the outcome variables that I am interested in are the percentage of children attaining the expected level, 2B or higher, and the percentage of children attaining level 3 or higher. This allows me to look at different parts of the distribution of results and examine whether early education is more effective in raising children to the expected standard or raising them to a level above this standard, and whether this depends on the deprivation level of the LEA. The results at level 3 or higher are only available from the results year 2002 onwards, thus the analysis at this level relies on four years of data for each LEA (results years 2002, 2003, 2004 and 2006) rather than five.

For the years 2001 to 2004, the published results refer to the children's attainments in a standard national task/test, thus this is a consistent dependent variable. From 2005 onwards however, the assessment altered slightly to be a teacher assessed level for the child – based on their performance in the standard national task/test but also taking into account the teacher's own knowledge of the child. Clearly this is something that could potentially affect results, and could affect things differentially across LEAs depending on the teachers' attitudes within each LEA. In light of the potential problems caused by this alteration in assessment method, I robustness check any results by running the regressions both with and without 2006 results data included (details available on request from the author).

Clearly there is a time-lag between the time that the children access their free early education place, and the end of Year 2 in primary school, when they have their KS1 assessments. This means that in terms of results data, the panel runs from 2001 to 2006, with a missing year in 2005 owing to the missing childcare data in 2002. The link up of the data is as follows:

1998	1999	2000	2001	2002	2003	*t*	**Early education data when age 3 (Jan)**
↓	↓	↓	↓	↓	↓		
1999	2000	2001	2002	2003	2004	*t+1*	**Early education data when age 4 (Jan)**
↓	↓	↓	↓	↓	↓		
2001	2002	2003	2004	2005	2006	*t+3*	**KS1 SATs scores when age 6/7 (May)**

With regard to the policy, for the first two 'waves' of the panel, 3-year olds could have an early education place in a maintained nursery or primary school if the LEA had capacity and allowed 3-year olds to be admitted. By the time of wave three (January 2000), the Nursery Education Grant was available to the 65 'poorer' LEAs allowing early education places to be taken by 3-year olds in the private sector, and by wave four (January 2001) this was extended to all LEAs. By the time the first pseudo-cohort of 3-year olds were 4-years old i.e. January 1999, the NEG was available for all LEAs for 4-year olds and all were entitled to a free early education place.

The structure of the link-up immediately leads on to a number of data issues. These data issues all relate to measurement error in the independent variables due to (a) the structure of schooling in England, (b) the potential for movement across LEA boundaries between pre-school and the KS1 tests, and (c) the accuracy of the National Statistics data on take-up and population. However, I am confident that in each

[22] Available from National Statistics via the NOMIS official labour market statistics website http://www.nomisweb.co.uk

[23] Available at http://www.dfes.gov.uk/rsgateway/DB/SFR/index.shtml in the National Curriculum Assessments of 7 year olds by Local Education Authority publications for each year.

case the measurement error is not systematically related to the levels of the explanatory variables, hence there should be only an attenuation bias introduced into the model's coefficients. Therefore I consider the positive coefficients to be the lower bound of the estimate of the effect (and any negative coefficients to be the upper bound of the estimate of the effect). More details of the specifics of these measurement error issues are contained in the Data Appendix.

6.2 Data Descriptives

The main estimation sample consists of 120 LEAs. For analysis of level 2B or higher results there are 575 observations in total, with each LEA contributing between 3 and 5 observations, with a mean of 4.79 observations per LEA. For level 3 analysis there are a total of 464 observations, with each LEA contributing between 3 and 4 observations with a mean of 3.87 observations per LEA. The reason for the slight unbalancing of the panel is that there are some observations (25 in the 5-year panel, 16 in the 4-year panel) that are data mis-reporting or coding errors resulting in large outlying values, which I exclude.

The exclusion of some LEAs results in the loss of a number of the group of 65 LEAs who were first given the NEG for 3-year olds. Remaining in the sample of 120 LEAs are 56 of the most deprived 65 LEAs, thus they make up 47% of the estimation sample of LEAs.

Tables 1-3 summarise the dependent and independent variables for the main estimation sample, both overall and separately for the two groups defined by whether they are the poorer ('first 65 LEAs' group) or the better off ('not first 65 LEAs' group).

As the identification in the model comes from within LEA changes in the independent variables affecting changes in the results within an LEA, it is useful to construct the within range of each variable for each LEA. The mean and median within range of each variable is reported in the final column of each table, to illustrate the extent of within LEA variation.

Table 1 shows that the mean percentage of children attaining L3 or higher in reading, across all LEAs is 27.00%. The median within range is 5%-points, and we can see from the breakdown of the standard deviation, that the within standard deviation is just under half of the overall, which shows that while there is obviously greater variation in results across LEAs, there is still variation within LEAs over time. For maths at L3 or higher we find a similar level of attainment (26.68% of an LEA's children on average attaining this level) and a similar overall distribution, though with more within variation – the within standard deviation is around two-thirds of the overall standard deviation and the mean and median within range are approximately double (at 10.06 and 10 respectively) the corresponding figures for reading. The mean percentage of children in an LEA attaining L3 or higher in writing is substantially lower, at 13.23%, than is the case for the other two subjects, though there is a quite a lot of variation much of which is within LEA variation over time – the within standard deviation is approximately three-quarters of the overall standard deviation, and at approximately 7%-points the mean and median within range is high compared to the mean attainment at this level.

As would be expected, the percentage of children attaining the expected level – 2B or higher – is much greater for each subject with 68.83 the mean percentage of children in an LEA attaining this level for reading, 59.55% for writing and 73.82% for maths. For each subject however the within variation is lower than for the L3 or higher results, reflected in the within standard deviations and the average within ranges.

Looking at Table 1(a), we see the same distributions broken down according to whether the LEA was one of the poorer 'first 65' LEAs. While the degree of within variation is generally the same for each group, and so for each mirrors the overall level of within variation for the subject, the means in each group differ as we might expect. For each subject and level, the poorer LEAs have a lower mean attainment than the better off by approximately 6%-points, which is more than one overall standard deviation in each case. The only exception to this is writing L3, which has a much lower mean overall and the difference in

means between the two groups is 3%-points which is just under one overall standard deviation. In each case the difference in means between the groups is statistically significant. Graph 1(a) uses kernel density plots to illustrate the distributions of results for each subject and level, separately for the first 65 LEAs and the not-first 65 LEAs, with the mean for each group marked in each case. The top row shows that for L3 or higher results, the shape of the distribution for each group of LEAs is similar, with the distribution for the first 65 LEAs, shifted to the left of the distribution for the not-first 65 LEAs, with the shift being slightly smaller for writing. For L2B or higher results (bottom row), the pictures confirm what the table tells us: that the first 65 LEAs' distribution is to the left of the distribution for the not-first 65 LEAs, and also show that the not-first 65 LEAs have a tighter distribution around the mean for each subject at this level, particularly so for maths.

These graphs confirm that there is not anything abnormal about the distributions of results in either group of LEAs, with the 65 LEAs that were targeted for increased early education funding first, having lower results in each subject at each level, looking at the data for the entire time period. Table 1(b) and 1(c) respectively show the mean attainment at L2B or higher (resp. L3 or higher) for each subject, separately for the two groups of LEAs, by year. Looking at each group of LEAs separately, it is clear that the means for each subject and level show variation over time, in some cases a large degree of variation – for example maths L3 or higher in 2006 has a dramatic reduction compared with the earlier years. However, the final column in each table, which shows the difference in means between the groups, illustrates that the gap is not closing over time for any subject at either level either as a result of the free early education places policy or any other initiative. If anything, for L2B or higher the gap is increasing in all subjects.

While the shape of results distribution remains approximately the same over time for a given subject and level, there are definite shifts of the distribution left or right dependent on the year. This is particularly the case for the level 3 or higher results. These differences in the positioning of the distributions over time confirm the necessity for including year dummies in the regression model to take account of the movements of the whole distribution over time.

Table 2 shows the distribution of the main explanatory variables. The mean take-up rate of free early education places for 3-year olds in the maintained nursery and primary schools is 43.09%, though there is a large variation across LEAs – the overall minimum being 1.02% with an overall maximum of 104.26%. These take-up rates in excess of 100% can occur due to the measurement error problems detailed above, mainly because of the possibility of children attending a place in an LEA different to their residential LEA. However, rates in excess of 100% occur in only a small number of LEA-years (5 out of 575). There is much less variation within LEAs overtime than there is overall, though the median within range is 4.37%-points so there is clearly some within variation.

As we would expect, the variation in the take-up rate of free places for 3-year olds in the 'other' sector is very much driven by within variation over-time – since the policy is introduced in two stages over time from an initial base of zero provision, the within variation is necessarily larger and the between variation less. The take-up rate gets as high as 74.53% in one LEA by the end of the time period, but the fact that all LEAs start at zero and do not have any places for the first two or three years weights the mean down to 12.89% overall. The mean and median within ranges are each just over 35%-points indicating the level of take-up that persists on average at the end of the time-period – since each minimum is necessarily zero and in most cases (117 out of 120 LEAs) the highest take-up is in the final year observed.

The take-up rates in nursery and primary school settings for 4-year olds are much higher than is the case for 3-year olds, on average almost double at 81.71%, and while there is variation overall (standard deviation overall is 11.99%-points) this is very much driven by across LEA differences, within variation being much smaller (within standard deviation is 2.12%-points). The mean and median within range of 5.02 and 4.37%-points respectively show that there is within LEA variation. Again there are some take-up rates in excess of 100% due to the aforementioned measurement error issue (19 LEA-years out of 575).

Take-up by 4-year olds in the private sector is much lower than in the public sector, with a mean take-up rate of 15.36%, and some LEA-years where there is no take-up in this sector[24]. Again there is variation (overall standard deviation is 10.31%-points) but it is mainly between LEAs (standard deviation 9.96%-points) rather than within LEAs over time (within standard deviation is 2.69%-points). However, the mean (6.03) and median (4.99) within range show that there is within LEA variation over the time of the panel.

In terms of the provision of childcare places, the table shows that playgroups places (mean 24.41 places per 100 children aged 3 or 4) are much more abundant than the day-nursery (mean 9.20) or childminder places (mean 10.22). Childminder and day nursery place provision have similar overall distributions, though childminder provision variation is more between LEAs with little within-LEA variation, whereas a large part of the variation in day-nursery place provision is within LEAs over time. Playgroup place provision has a much greater range overall and while there is a large amount of between LEA variation, there is within LEA variation with a mean within range of 8.45%-points, median 6.84%-points.

As expected, the overall distributions mask substantial differences in take-up rates and provision between the more and less advantaged LEAs, as can be seen in Table 2(a). It has been documented (Brewer *et al.*, 2005) that more deprived areas have access to fewer private providers and therefore have to rely heavily on the maintained sector, and this is clearly seen in the take-up rates for free early education places for 3-year olds between the more and less deprived LEAs. The mean take-up rate of places in the maintained schools sector in the poorer LEAs is 59.39%, compared to just 28.77% in the better off areas and this difference is statistically significant. The variation is slightly greater overall and between LEAs for the better off LEAs, which is what we would expect given that the better-off LEAs are a more heterogeneous group than the poor LEAs which by definition are all similar in terms of deprivation. As the policy of increasing free early education places is differentially targeted towards the more deprived LEAs we would expect that they would have the greater within variation over time and this is what we observe in terms of the average within ranges for this variable for the two groups of LEAs. Graph 2(a) shows for each year, the 25th, 50th and 75th percentiles of the distribution of take-up rates by 3-year olds, of free early education places in the maintained nursery and primary schools, separately for the two groups of LEAs. The graph illustrates these differences showing the first 65 group of LEAs have a much higher take-up and less of a spread, exhibited by the relative closeness of the three percentile lines shown. The take-up rate is lower on average in the better off LEAs and as we would expect with this more heterogeneous group, there is a greater spread of take-up rates, as can be seen in the right panel of the graph. Over time the overall distributions for each group of LEAs are very stable with in each case a slight upward trend in the take up rate at each point in the distribution.

For the main variable of interest – take-up by 3-year olds of free early education places in the 'other' sector – the two groups have means that are very similar (13.85% for the poorer LEAs, 12.05% for the better off) and indeed the difference is not statistically significant. However, there are two effects at work: on the one hand the better-off LEAs have access to more private provision, but on the other hand, the poorer LEAs had the NEG funding for 3-year olds a year earlier thus were increasing take-up from zero sooner. Again the mean and median within range provide an indication of average take-up rates at the end of the period since all LEAs begin with zero take-up and take-up is almost always increasing within LEA over time. We can see that the better-off LEAs have a mean within range of 41.79%-points (median 43.71) compared with a mean within range of 28.79%-points (median 30.66%-points) in the poorer LEAs. Thus despite having the funding for free early education places in the private sector a year later than the poorer LEAs, this indicates that the better-off LEAs have over-taken in terms of average take-up in the private sector by the end the of the panel. This pattern is confirmed if we look at Graph 2(b) which shows for each year, the 25th, 50th and 75th percentiles of the distribution of take-up rates by 3-year olds of free early education places in the 'other' sector for each group of LEAs. For 1998 and 1999 (and also for 2000 for the better off LEAs) there were no free early education places in the 'other' sector, hence the

[24] This is the case in 22 out of 575 main sample observations. 21 of these were set to zero in the variable's construction due to an implied negative take-up in this sector in the LEA-year (see data appendix for details).

horizontal lines at zero for the 25th and 75th percentiles and the median for these years. However we see that the take-up rate shoots up to a median of 16.6% in 2000 for the poorer LEAs and continues to increase year on year thereafter. The better off LEAs receive the funding for the first time in 2001 and their median take-up in this sector rises to 9.7% in this year – which is below the corresponding figure of 25.2% for the poorer LEAs in 2001. However, by 2002 the better off LEAs have a higher take-up rate at each point of the distribution shown here, and the gap is massively increased by 2003, with the median take-up rate in this sector for the better off LEAs reaching 43.7%. This graphic dramatically illustrates the way in which the better off LEAs quickly surged ahead in terms of the take-up of what are essentially privately provided early education places.

As is the case with 3-year olds, the more deprived LEAs have a greater take-up of maintained sector places by 4-year olds (88.08% mean take-up in the more deprived LEAs, 76.10% in the less), and though this difference is statistically significant, it is not as stark a contrast. Though the better-off LEAs have greater access to private provision of early education, by the age of 4 many children are attending the reception or infant class of the primary school that they will attend, and as private school attendance is much lower than maintained school attendance – particularly at primary level – the difference in take-up by 4-year olds of pre-compulsory school places between the poorer and better-off LEAs is not nearly as large as is the case when the children are 3. Again the between LEA variation is greater for the better-off LEAs while the poorer LEAs have slightly greater within variation both in terms of the average within range and also the within standard deviation.

As the Nursery Education Grant funding for private places for 4-year olds was available to all LEAs from the start of the panel, it is not surprising to see that the better-off LEAs have a greater take-up rate of private sector places, more than double the average take-up rate of the poorer LEAs (20.36% versus 9.69%), a difference that is statistically significant. There is more between LEA variation amongst the better-off LEAs and also there is slightly more within LEA variation amongst these LEAs too, though again we may expect this to be the case as take-up of free early education by 4-year olds in the private sector is likely to be associated with private school attendance for primary school which we expect to see less of, and see less change in, for the poorer LEAs.

In terms of childcare places provided, while the day nursery and childminder place provision is similar in the two groups of LEAs, slightly less provided in the poorer LEAs as we would expect (though not a statistically significant difference for day nursery places), it is playgroup place provision where the difference is large. The better off LEAs provide on average 31.22 playgroup places per 100 children aged 3 or 4, compared with an average of just 16.65 in the poorer LEAs. This may explain why the take-up of free early education places by 3-year olds in the maintained schools sector is much lower in the better off LEAs, if many are using childcare settings rather than formal education settings at age 3.

Table 3 contains the descriptive statistics for the additional control variables included in the regressions when I allow differing effects for the poorer and better-off LEAs. This is then broken down for the two groups of LEAs in Table 3(a). As we would expect, the poorer LEAs have a higher economic inactivity rate amongst working age males (19.66% versus 13.05%) and the difference is statistically significant, while the variation between LEAs and within LEAs over time is similar for each group. The average manufacturing occupations rate and the average of median male worker weekly gross pay however are not statistically different between the two groups of LEAs and indeed the poorer LEAs actually have a higher average of median male worker weekly gross pay. We can see that within LEA variation is very similar for this variable in the two groups but between LEA and overall variation is greater in the poorer LEAs – this is because of a small number of LEAs in the poorer group who nevertheless have high levels of median gross income[25]. The earnings measures available in my data are not ideal in that they are based on workplace rather than residential location. This allied to the fact that some of areas that qualified for the early NEG funding as a "deprived" LEA actually have some very prosperous areas in addition to very

[25] Tower Hamlets, Southwark, Camden, Westminster, Islington, Hammersmith and Fulham.

poor areas, means that we get this slight anomaly. Consequently a few large outliers skew the data – while the mean of median male gross weekly pay is higher in the poorer LEAs, the median of this variable is lower: £389.80 in the poorer LEAs versus £401.95 in the better-off LEAs.

In terms of average KS1 class size, the groups are almost identical in mean (25.65, poorer LEAs; 25.63 better-off) and also in terms of the variance of the distribution both between and within LEAs. It is noticeable that the poorer LEAs have a significantly higher average percentage of non-white children in their maintained schools: 27.38% compared with 10.75% in the better-off LEAs. There is slightly more variation in the poorer group of LEAs both across and within LEAs, with some poorer LEAs having a particularly high concentration of non-white children – the highest overall in any LEA-year being 80.91%, and the highest time-average for a poorer LEA being 77.47%, compared with the corresponding figure of 58.64% for the better-off LEAs. It is important therefore to include these covariates to control for any potential effects that this may have on KS1 results.

7 Results

7.1 Policy Evaluation

The initial model is a panel regression with a simple [0,1] policy dummy for the years in which the policy is in operation; the results are displayed for reading, writing and maths at each level, in model #1 columns of Tables 4, 5 and 6 respectively. Looking at the tables we see that, despite the introduction of the policy at two different time points, we cannot identify a significant effect of the policy introduction on reading, writing or maths results at either level. At level 2B or higher the estimated policy effect is almost zero for reading, while for writing the coefficient is +0.255 indicating that the policy had the effect of increasing the percentage of children attaining level 2B or higher by 0.255%-points, though it is not significantly different from zero. Similarly for maths, the estimated coefficient of -0.250 suggests that the policy reduces attainment at level 2B or higher by a quarter of one percentage point though again it was not significant. The year dummies are highly significant in all years for writing and in two of the four later years for reading and for maths, and when this common year variation is removed, it appears that there is not sufficient variation in results within LEAs to identify the effect of the policy.

The story is similar for level 3 or higher results, each of the year dummies are significant at the 1% level for each subject, and once this common variation is removed, the remaining variation in results is not sufficient to identify the policy effect. Robustness checks on additional samples confirm that we do not get any significant coefficients for either level in any of the samples, though there is generally a consistency to the point estimates for each subject and level across the samples[26].

The second specification of the policy evaluation model allows the policy effect to differ according to whether the LEA was one of the poorer LEAs that had the policy implemented in the first phase of its introduction. The results for this model can be seen in Tables 4, 5 and 6 but under the model #2 columns. We can see that for level 2B or higher reading and writing, we continue to fail to identify policy effects in either group of LEAs. It is interesting that while not significant estimates, for writing at this level there is a positive effect of the policy for each group of LEAs, whereas for reading the effect is estimated to be negative for the poorer LEAs but positive for the better off LEAs. This pattern for reading is also witnessed in the maths results at level 2B or higher, but for maths while the positive effect for the better off LEAs is not statistically significant, the negative effect for the poorer LEAs ***is*** significant at the 5% level. The estimate of -0.772 suggests that in the poorer areas, the policy led to a 0.772%-point fall in the percentage of children attaining level 2B or higher in KS1 maths. To put this in context, the average attainment at this level in the poorer LEAs is 70.79% with a within standard deviation of 2.02%-points. Therefore the policy effect is equal to a reduction of approximately 1/3 of a within standard deviation.

[26] Details of the robustness check results for all estimated models are available on request from the author.

This result is consistent across the samples, remaining of similar magnitude and significant at the 5% level and in one sample at the 1% level.

Turning to the level 3 or higher results for model #2, Table 4 shows that for reading there is a positive effect of the policy for each group and in the case of the poorer LEAs there is a marginally significant (p=0.112) coefficient of 0.425 estimated. This suggests a 0.425%-point increase in the policy years for these poorer LEAs. The mean attainment in reading at this level in these LEAs over the period is 23.41 with a within standard deviation of 1.90, therefore the policy effect is equivalent to approximately one fifth of a within standard deviation of results for these LEAs.

Similarly for writing level 3 or higher we see from Table 5, that there is a marginally significant (p=0.107) coefficient of -0.728 estimated for the policy effect in the poorer LEAs. This suggests that the policy decreased the average percentage of children in the poorer LEAs' maintained schools attaining level 3 or higher in writing by 0.728%-points, which is approximately one quarter of a within standard deviation (2.76%-points), with the mean being 11.39%. The effect for the better off LEAs is positive but not significant.

Table 6 shows that for maths at level 3 or higher, while the policy effect for the better off LEAs is not significantly different from zero, the policy effect coefficient estimated for the poorer LEAs is -0.825 and is significant at the 5% level. This suggests that the policy led to a 0.825%-point reduction in the percentage of children in the poorer LEAs' maintained schools attaining level 3 or higher in KS1 maths, which is approximately one fifth of a within standard deviation (4.03%-points), while the mean is 23.50%. These results are robust to the choice of sample and in many cases strengthen in significance in the alternative samples; moreover, all of these results remain when we exclude the 2006 data on account of the change in assessment method introduced in 2006.[27]

It appears that there is a significant policy effect on results but that it is only in evidence when we allow the policy to have different effects in the two groups of LEAs, and the effect is only in the poorer LEAs. While there is a slightly significant positive effect on reading level 3 or higher in the poorer LEAs, for writing and maths it is a significant *negative* effect of comparable or greater relative magnitude. The negative policy effect on maths results in the poorer LEAs is also in evidence in attainment at level 2B or higher. These are interesting results and slightly alarming in that the policy was designed to be a benefit to the poorer LEAs in particular and it is in these areas that the policy is having a significant and mainly negative impact on results. To investigate further I estimate the more complex model, exploiting variation in the actual take-up rates to examine the channels through which this policy is working.

7.2 Policy Effect Channels

Looking at the results from first specification of the more complex model in Tables 7 – 9, we see that despite the fact that the expansion of the 'other' sector provision of free early education places began at different times in the two groups of LEAs, there is a failure to identify any effect of this expansion on results in reading, writing or maths at either level 2B or higher or level 3 or higher. Indeed, aside from the year dummies, there are very few coefficients that are significant in any regression. It appears that, as with the corresponding basic policy evaluation regressions, the variation common to all LEAs according to the year of the test, dominates other differences in results to such an extent that we cannot identify any significant parameters.

The exception to this is the effect of the take-up, by 3-year olds, of free early education places in maintained nursery schools and nursery classes in maintained primary schools on the proportion of children achieving level 2B or higher in reading. As can be seen in Table 7, we find a significant positive

[27] We also robustness check the results by running the regression including results year 2005 which is excluded from the complex regressions due to missing data, and all results remain (details available on request from the author).

effect, though the coefficient of 0.037 is very small – a 10%-point rise in the 3-year olds take-up rate of these places would lead to a 0.4%-point increase in the percentage of children achieving level 2B or higher at KS1 reading. To put this in context, over the time of the panel, the mean take-up rate by 3-year olds of free early education places in maintained nursery schools and nursery classes in maintained primary schools is 43.09% and the mean percentage of children attaining level 2B or higher in reading is 68.83% with a within standard deviation of 1.70. Therefore the effect is equivalent to an increase in attainment of approximately one quarter of a within standard deviation. This result is robust to the various robustness checks[28] (details available on request from the author).

As discussed in section 5, the introduction of the policy to make mandatory the provision of free early education places to all 3-year olds, was a shock to the whole market and therefore the influence may be felt not only through the places in the 'other' sector that were taken up from an original position of zero take-up, but also through the maintained schools sector take-up. However, while it is true that the selection into the maintained schools' places as opposed to the 'other' sector is no longer on the basis of cost, since **all** places are free, I make the assumption that there is not systematic selection on other unobservable parental tastes, in order to able to interpret these maintained schools sector effects as causal.

While it is disappointing not to find more significant effects at this stage, an important part of this study involves evaluating whether there are differential effects of the changing balance between public and private providers of free early education places, according to the level of deprivation of the LEA. Tables 10 – 12 display the results of the regressions when I allow the effect of each of the early education take-up rate variables to vary according to whether or not the LEA was one of the poorer LEAs who were allocated the Nursery Education Grant first. Many of the control variables to capture selection into the first group of LEAs to receive the NEG did not prove to have any significant effect – individually or collectively – thus in the interests of parsimony have been dropped.

7.3 Reading

In the policy evaluation regressions when we allow the policy effect to differ for the 'poorer' and 'better off' LEAs we found the effect on reading level 2B or higher was negative for the poorer LEAs, positive for the better off LEAs, though in neither case significant. Table 10 shows that the coefficients on take-up in the non-school sector, that is the 'other' sector, follow this same pattern as we would expect, however again neither effect is significant.

What we do find is that it is the poorer LEAs that are driving the result that increasing the take-up by 3-year olds of free early education places in maintained nursery and primary schools has a positive effect on achievement in reading at level 2B or higher, as Table 10 shows. The coefficient is still small at 0.059, implying that a 10%-point rise in the take-up rate of these places by 3-year olds in the poorer LEAs would lead to a 0.6%-point increase in the percentage of children achieving level 2B or higher at KS1 reading. The mean take-up of these places by 3-year olds in the poorer LEAs is 59.39% and the mean percentage of children achieving level 2B or higher in reading in these LEAs is 65.68% with a within standard deviation of 1.66. Therefore the effect of a 10%-point increase in take-up would be equivalent to an increase of approximately one-third of a within standard deviation for these LEAs. The result is robust to the various checks (see footnote 28, details available from the author on request).

Turning to the effects at level 3 or higher, the marginally significant positive policy effect for the poorer LEAs that we found in Table 3 is not in evidence in Table 10 – we find the coefficient on 'other' sector take-up to be estimated to be zero to 3 decimal places. However, we do see in Table 10 that there is some evidence that take-up of free early education places in maintained nursery and primary schools by 4-year olds in the better off LEAs, has a positive effect on the percentage of children in an LEA attaining level 3

[28] In addition to using additional samples, I exclude 2006 data as a robustness check, and also exclude the alternative childcare provision variables which allows data from 2005 to be included in the model as another robustness check.

or higher in their KS1 reading. The coefficient of 0.159 indicates that an increase in the 4-year olds take-up rate of these places in the better off LEAs is associated with a 1.59%-point increase in the percentage of children attaining level 3 or higher. To put this in context, the mean take-up rate of free places in the maintained nursery and primary schools by 4-year olds in these less deprived LEAs is 76.10%, and the mean percentage of children attaining level 3 or higher in these LEAs is 30.15% with a within standard deviation of 2.14. Therefore the effect of a 10%-point increase in take-up is approximately equal to an increase of just under three quarters of a within standard deviation. The result is largely robust to various checks though some sensitivity to sample choice is apparent in some of the robustness checks (details available from the author on request).

It is notable that some of the variables that are included to control for selection into the group of LEAs who received the NEG for 3-year olds first, are significant in each regression. In the level 2B or higher regression the male economic inactivity rate amongst working age males is significant and negative which is what we would expect to be the case – as the inactivity rate increases the results for children in these LEAs decrease. Similarly, there is a negative coefficient on the proportion of men and women who are employed in manufacturing occupations for results at level 2B or higher. This again is the sign that we would perhaps expect – to the extent that manufacturing jobs capture socio-economic status of the LEA, as the proportion of manufacturing jobs increases we might expect that results would decrease.

In the regressions for level 3 or higher, the male economic inactivity rate is no longer significant, and neither is the manufacturing jobs rate (which in the interest of parsimony is dropped from the specification). The median gross weekly pay of male workers is significant and had a positive effect, again as we would expect – as the pay of workers increases, the results of children in the LEA increase.

It is in line with what we would expect that factors contemporary to the time that the children take the test have a larger impact on results than factors from earlier in the lifetime of the children – and it is clear that average class size for KS1 classes seems to have a significant effect on results for reading at each level. As we would expect, as the average class size increases, results decrease: increasing the average class size by 1 child has the effect of decreasing the percentage of children attaining level 2B or higher by 0.67%-points and the percentage of children attaining level 3 or higher by 0.78%-points. As the mean percentage attaining level 2B across all LEAs is 68.83% with a within standard deviation of 1.70 and the corresponding figures for level 3 are 27.00% and 2.03, it is clear that even changing average class size has only a relatively small effect on results.

7.4 Writing

In the policy evaluation regressions when we allow the policy effect to differ for the two groups of LEAs, for both there was a positive policy effect on results at level 2B or higher but in each case it was not significant. The effect of the 'other' sector place take-up continues to be non-significant for each group of LEAs in Table 11, with the coefficient for the poorer LEAs actually being slightly negative though very close to zero.

While there were no significant results for writing in the regressions estimating common effects for the two groups of LEAs at level 2B or higher, Table 11 shows that when we allow for different effects we find that there is evidence of a small positive effect of take-up of free early education places in maintained nursery schools and nursery classes in primary schools by 3-year olds in the poorer LEAs, on the percentage of children attaining level 2B or higher in writing at KS1. As with the result for reading, the coefficient is very small at 0.07, indicating that a 10%-point increase in take-up by 3-year olds in these poorer LEAs would result in a 0.7%-point increase in the percentage of children attaining level 2B or higher. As outlined above, the mean take-up rate by 3-year olds of free early education places in maintained nursery and primary school settings in these LEAs is 59.39%, while the mean percentage of children in these LEAs attaining level 2B or higher in writing is 56.30% with a within standard deviation of 2.19. Therefore a 10%-point increase in take-up is associated with an increase in attainment at this level

equivalent to approximately just under one-third of a within standard deviation. This result is robust to the various robustness checks (details available from the author on request).

The first main result therefore, is that there is a small but significant and robust effect of take-up of free early education places in maintained nursery schools and nursery classes in maintained primary schools, by 3-year olds in the poorer LEAs, on the percentage of children achieving level 2B or higher in KS1 reading and writing. It is perhaps not surprising that settings that increase results for reading also affect results for writing given the obvious complementarity between the two skills, and it appears that in the poorer LEAs there is a positive effect of increasing take-up of free early education in the state maintained schools sector.

Turning to level 3 or higher results, in the policy evaluation regressions when we allow the policy effect to differ for the two groups of LEAs, we found a significant *negative* policy effect on results at level 3 or higher for the poorer LEAs, and a non significant positive effect in the better off LEAs. Table 11 shows that the signs on the estimated coefficients for take-up of 'other' sector places by 3-year olds in each group of LEAs concur with the policy evaluation regressions though in neither case are they significant.

We also see in Table 11 that there is some evidence that take-up of free early education places in maintained nursery and primary schools by 4-year olds in the better off LEAs, has a positive effect on the percentage of children in an LEA attaining level 3 or higher in their KS1 writing. The coefficient of 0.157 indicates that a 10%-point increase in the take-up rate of these places by 4-year olds in the less deprived LEAs is associated with a 1.57%-point increase in the percentage of children attaining level 3 or higher. To put this in context, as outlined above, the mean take-up rate of free places in the maintained nursery and primary schools by 4-year olds in these less deprived LEAs is 76.10%, while the mean percentage of children attaining writing level 3 or higher in these LEAs is 14.84% with a within standard deviation of 3.19. Therefore the effect of a 10%-point increase in take-up is approximately equal to an increase of half of one within standard deviation. As with reading at this level, the result is largely robust to various checks though some sensitivity to sample choice is apparent in some of the robustness checks (details available from the author on request).

Therefore, the second main result is that there is a significant and robust effect of take-up of free early education places in maintained nursery and primary schools, by 4-year olds in the better off LEAs, on the percentage of children achieving level 3 or higher in KS1 reading and writing. Again we see a common positive effect – almost identical in terms of the coefficient – on reading and writing, of the state maintained nursery and primary school settings providing free early education places, though in this case it is the higher level of attainment and the better off LEAs.

It is also clear that for reading and writing regressions, the extra variation that comes from including the actual take-up rates of free early education places in the 'other' sector rather than just a simple dummy for the policy implementation does not lead to greater identification of the policy effects. As shown in Tables 10 and 11, we cannot identify the effect of the introduction of these non-school sector free places for results in either subject or at either level.

In the writing regressions, the covariates included to attempt to control for selection into the group of LEAs that had the policy implemented earlier, are not always significant or of the expected sign. In the regression for level 2B or higher attainment both the male economic inactivity rate and the manufacturing jobs rate have negative coefficients of similar magnitude to the corresponding coefficients in the reading regression at this level, however in the case of writing, they are not quite significant. In the regression for level 3 or higher, the male wage and economic inactivity variables – that were included for the reading regression at this level – are not anywhere near significant and therefore dropped from the model in the interest of parsimony. However, the manufacturing jobs rate is included and has a significant positive coefficient. The sign is in contrast to the case for reading at this level and is not what we would expect to be the case.

In the regressions at each level, we find that the average class size for KS1 enters again with a significant negative coefficient. For level 2B or higher the coefficient is -0.948 suggesting that for every extra child added to the average class size, the percentage of children attaining this level decreases by approximately 1%-point. While the coefficient on average KS1 class size from the level 3 or higher regressions (-0.450) suggests that for every additional child added to the average class size, the percentage attaining level 3 or higher falls by less than half of one percentage point. Since the mean percentage of children attaining level 2B or higher in writing, across all LEAs is 59.55% with a within standard deviation of 2.10, the effect is approximately half of one within standard deviation. For level 3 or higher it is relatively even smaller since the mean percentage attaining this level across all LEAs is 12.23% with a within standard deviation of 2.99, thus the effect of increasing average class size by 1 child is less than one sixth of a within standard deviation. Therefore, similarly to the case of reading, average KS1 class size has a significant and robust effect on all levels of writing attainment, though again the effects are relatively small in magnitude.

7.5 Maths

In the policy evaluation regressions with differing effects for the poorer versus the better off LEAs, there was a significant negative policy effect for the poorer LEAs on attainment at level 2B or higher, and a positive but not significant effect for the better off LEAs. As we can see from Table 12, the coefficient on take-up in the 'other' sector for the poorer LEAs is negative but is not quite significant. However, the positive coefficient on take-up of 'other' sector places by 3-year olds in the better off LEAs is significant at the 5% level. In magnitude the coefficient is very small at 0.018, indicating that a 10%-point increase in the percentage of 3-year olds in these LEAs taking a free early education place in a setting in the non-school sector would lead to an increase of less than one-fifth of one percentage point in the percentage of children attaining level 2B or higher in maths. The percentage of children attaining this level in maths in the better off LEAs is 75.48% with a within standard deviation of 1.66. The effect of a 10%-point increase in take-up is therefore equivalent to less than one eighth of a within standard deviation. Moreover, the result is sensitive to the various robustness checks (again details available from the author on request).

At level 3 or higher, the policy evaluation regressions found a significant negative policy effect in the poorer LEAs. Table 12 shows that we do still pick up this effect in the coefficient on 3-year olds take-up of 'other' sector places in the poorer LEAs, though the coefficient of -0.025 is just outside the 10% level of significance (p=0.102). This result is largely robust to the various checks, and the coefficient suggests that a 10%-point increase in 'other' sector take-up in the poorer LEAs would decrease the percentage of children attaining level 3 or higher by a quarter of one percentage point. To put this in context, the mean take-up rate of 'other' sector places amongst 3-year olds in these LEAs is 13.85% and the mean percentage of children attaining level 3 or higher in maths in these LEAs is 23.50% with a within standard deviation of 4.03, so the effect is around one sixteenth of a within standard deviation.

Table 12 also shows that there is some evidence of an effect of take-up of free early education places in maintained nursery and primary schools by 4-year olds in the better off LEAs on results in maths at level 3 or higher. The coefficient of 0.155 suggests that a 10%-point increase in the take-up of places in these settings by 4-year olds in these LEAs is associated with a 1.55%-point increase in the percentage of children attaining level 3 or higher in maths. To provide some context, the mean take-up rate in these school settings amongst 4-year olds in these LEAs is 76.10% and the mean percentage of children attaining level 3 or higher in maths in these LEAs is 29.48% with a within standard deviation of 4.15, thus the effect is equivalent to just over one third of a within standard deviation. It is noticeable that the coefficient is very similar to the effect that we find for both reading and writing attainment at level 3 or higher in these better off LEAs. Again this result is largely robust to the various robustness checks.

Therefore there is some evidence to suggest that the positive effect that we see for reading and writing of early education places being taken in the maintained nursery and primary school settings by 4-year olds in the better off LEAs is also present in maths – and of a similar magnitude.

At each level, the covariates included to control for selection into the group of LEAs who received the NEG first, are generally not significant. At level 2B or higher there is a slightly significant effect of the manufacturing jobs rate, with a negative coefficient as we may expect. However this is the only such variable that is significant and this is only at the 10% level. Including different variables in different combinations as controls does not yield any significant coefficients for these variables. Similarly, at level 3 or higher, the particular covariates we use as controls does not seem to make a difference. Including different combinations of control variables does not yield any significant effects of these variables. As we know from the reading and writing regressions that there is variation in these control variables – it is not simply the case that they do not vary sufficiently in any LEAs to be able to obtain any identification – their non-significance in the maths regressions leads me to conclude that they are not having any significant impact on the results in maths and therefore are not biasing the coefficients for either group.

As with the reading and writing regressions, the average class size at KS1 has a significant negative effect on results at both levels for maths. For level 2B or higher, an increase of 1 child in the average class size has the effect of reducing the percentage of children attaining this level by 0.425%-points, which is just under one quarter of a within standard deviation (1.84). For level 3 the effect is to reduce the percentage achieving this level by 0.726%-points, which is just over one-sixth of a within standard deviation (4.09).

We can see that the proportion of children in the LEA at the time of the KS1 tests, who are from non-white ethnic origin has a significant (at 1% level) negative effect on the proportion of children attaining level 2B or higher in maths, though this only seems to affect level 2B or higher as there is no measured effect on level 3 or higher attainment.

7.6 Implications

The policy evaluation regressions show that there is a significant effect on some subjects' results of the policy introduction but that it is not universal – the effect is different in the two groups of LEAs and only significant for the poorer LEAs. Common variation due to the year effects accounts for much of the variation in results, with the remaining local variation insufficient to identify a common policy effect in the simplest regressions. In several cases the policy has a different signed effect between the groups and it appears that these effects counter act each other such that when estimated as a single effect it is not significantly different to zero. In other cases it is only a marginally significant effect in the poorer LEAs and not significant in the better off LEAs such that when estimated as a single parameter the poorer LEAs' effect is not strong enough to identify a significant overall effect.

In terms of evidence of the policy effects working through the actual take-up rates of 'other' sector places themselves, it is only in maths scores that we see the significant policy effects mirrored by the significant 'other' sector take-up rate impacts. In the better off LEAs there is a positive (though not significant) policy effect for maths at level 2B or higher and this is echoed and significant in the estimation of the effect of the take-up rate of 'other' sector places in these LEAs. For level 3 or higher results the policy evaluation regressions suggest a negative policy effect on results in the poorer LEAs, and this effect is identified in the coefficient on the take-up of 'other' sector places in these LEAs, in the more complex model regressions. However, these maths results are sensitive to the choice of sample and do not remain in all of the other robustness checks.

Looking at the more indirect effects, it appears that for both reading and writing the maintained nursery and primary school settings have a small but significant positive effect on attainment at the intermediate level for the poorer LEAs when accessed by 3-year olds. These settings are also associated with a larger and significant positive effect on attainment at the higher level for the better off LEAs when accessed by 4-year olds.

However, for 4-year olds it is not possible to interpret this as a causal effect. The introduction of free early education places for 3-year olds was a shock to the market for childcare and early education for 3-year olds but much less so for 4-year olds. The choice of setting for 4-year olds is likely to be much more influenced by the consideration of where the child will be for their primary school education – the nursery and primary school settings for 4-year olds include the reception class, which children can attend for between one and three terms depending on the choice of the parents and the birthday of the child. Table 13 shows the percentage of 4-year olds attending a nursery or primary school that are in an infant or reception class as opposed to a nursery class, for each region of England for 1998-2002[29]. It is clear that a large majority of 4-year olds in nursery and primary school settings are in fact in an infant or reception class in the primary school – and thus in the school that they will attend for their primary education. Therefore the choice to send the child to a maintained school setting rather than a private setting at age 4 is likely to be strongly influenced by the parents' preferences over primary schools and therefore it is not appropriate to assume that within the LEA, allocation of 4-year olds to school or non-school sector settings is uncorrelated with unobservables. We would suspect there could be a significant upward bias in the estimated effect: parents with strong preferences over their child's education are likely to try to get their 4-year old into a reception class in a particular, good primary school rather than use a free place in a private nursery setting. The children of these parents are also more likely to achieve higher results due to the parental preferences over education, leading to an upward bias in the coefficient on 4-year olds attendance of maintained school places.

It is worth noting that this argument does not apply to the case of 3-year olds since it is policy that attendance at a maintained school as a 3-year old does not have any influence on the probability of gaining a place in the reception intake at that school. Thus the link between early education place setting and primary school place does not exist for 3-year olds in the way that it does for 4-year olds and is therefore much less likely to create a selection problem. In theory the early education places for 3-year olds in the school and in the non-school settings are identical so a parent with strong educational preferences should view them as equal and not select on this into either particular sector.

The effect of maintained school settings' attendance by 3-year olds in the poorer LEAs on their reading and writing results is in line with what our prior may be. I am comparing the effect of attendance in one of the settings with staying at home and not attending any setting and it appears that, compared with staying at home, a greater proportion of the LEA's children attending a maintained nursery setting aged 3 is associated with more children attaining the expected level (i.e. at least level 2B) on their KS1 assessment. If we expect that the average home environment for children in these poorer LEAs is less educationally beneficial to a child than attendance part-time in a nursery school setting, then we would expect that increasing take-up by 3-year olds in these LEAs would be associated with positive effects on child outcomes. Given that reading and writing in particular are skills more readily advanced through nursery school attendance (as opposed to maths skills), we might expect that we would find effects on results in these areas.

If we believe that for the better off LEAs, the quality of home inputs is on average better, then it may be no surprise that attendance in more formal settings aged 3 or 4 does not seem to affect the intermediate level of attainment but attendance at age 4 does have a significant effect on attainment at the higher level – and for maths also. As discussed, there is likely to be an upward bias in the coefficient due to selection. However, it is also consistent with the idea that children who develop skills early can be encouraged to develop further and *beyond* expectations in the more formal nursery and primary school settings whereas this may be more difficult at home.

It is noticeable that the effects at level 3 are greater in magnitude and relative size than the results at level 2B and again this could be due to an upward bias but is also in line with what our prior may be. Bearing in mind that I am unable to distinguish between no effect at all and an effect that is mitigated by the first two

[29] 2001 is missing due to data non-collection in this year, this is also the case for 2004.

years of formal schooling, it is perhaps to be expected that the first years of schooling would do a better job of mitigating any advantage that nursery attendees had over their home-staying class mates at the intermediate level, to the extent that the measured effect on KS1 results whilst statistically significant in the poorer LEAs, is relatively small. For the higher level results, it may be more likely to be the case that the advantage of early exposure to the formal educational setting remains, if this gives the platform on which to build – with the initial schooling having a greater gap to make up if these children in better off LEAs who attend early education places are in a better position to build on their early advantage. As Table 13 shows that a large proportion of 4-year olds in nursery and primary school settings are in fact in an infant or reception class in the primary school, the "result" for 4-year olds suggests that results are better at the higher levels for reading, writing and maths in the better off LEAs when more children start school at age 4 rather than remaining at home aged 4.

It has to be borne in mind that the measurement error issues inherent in the data would suggest that the estimated coefficients are lower bounds for the estimates of the true parameters. However, even taking this into account, in terms of policy implications conclusions are tempered by the magnitudes of the robust results that I find. As discussed above, if the take-up of early education places in maintained nursery and primary schools, by 3-year olds in the poorer LEAs, could be raised by 10%-points, the effect would be to increase the percentage attaining level 2B or higher in reading by just 0.6%-points and in writing by 0.7%-points. Over the time of the panel, the mean percentage of children in these poorer LEAs attaining level 2B or higher in reading is 65.68% with a within standard deviation of 1.66%-points – so we can see that even a 10%-point change in take-up is making only a relatively small impact. Similarly the mean attainment in these LEAs for writing level 2B is 56.30% with a within standard deviation of 2.19%-points thus even more so for writing, the impact of increasing take-up even by 10%-points is relatively small.

One way in which to assess these findings is to consider what the estimated effect would be, *ceteris paribus*, if all of the 3-year olds in the poorer LEAs who attend non-school sector places switched to school sector places. At the end of the panel, the median take-up of places in the non-school sector by 3-year olds in the poorer LEAs was 30.29% (mean 28.77%). If the take-up in the maintained schools sector increased by 30%-points the effect on reading level 2B would be to raise results by approximately 1.8%-points which is just over one within standard deviation. For writing level 2B the effect of a 30%-point increase in maintained school place take-up would be an increase of approximately 2.1%-points which is just under one within standard deviation. Therefore this admittedly basic calculation (not taking into account capacity constraints or allowing non-linear effects in increasing take-up) suggests that expanding the maintained schools provision of places for 3-year olds in the poorer areas, in the stead of private places, would lead to a significant increase in reading and writing results.

One other way in which to think about the size of these significant parameters, is to compare the effect of a 10%-point increase in the take-up rate of free early education places in the maintained schools sector, by 3-year olds in the poorer LEAs, with the effect of reducing the average KS1 class size by one child[30].

The effect of increasing take-up by 3-year olds in the poorer LEAs by 10%-points, would for reading level 2B or higher, have an effect equivalent to reducing the average KS1 class size by one child. Put in this context, we can see that though the effect of raising this take-up rate seems very small, it is of the same order as reducing class size by one child. For writing level 2B or higher, the effect of increasing take-up rate by 3-year olds in the poorer LEAs by 10%-points is not quite as great in comparison to reducing the average class size. Such an increase in take-up rate would correspond to a reduction of approximately three-quarters of one child, or put another way, it would take an increase in the take-up rate by 3-year olds in the poorer LEAs, of approximately 14%-points to have an effect on results equivalent to a reduction by one child in the average KS1 class size. Again, in this context, the seemingly negligible effects of an

[30] Clearly this exercise makes the simplifying assumption that there is a monotonic effect of reducing KS1 class sizes, which in reality is not likely to be the case.

increase in 3-year olds in poor LEAs taking their free early education place in maintained schools settings, is seen to be of more substantial size than initially thought.

8 Conclusions

The aim of this study was to evaluate whether the policy of introducing free early education places for all 3-year olds has had any impact on results at Key Stage 1, and moreover to see whether there has been any additional effect in the areas deemed most in need of free early education places. As the Government has invested in the Nursery Education Grant system to allow the funding of places in private settings in order to circumvent capacity problems in the maintained sector, it is worth examining whether, in terms of educational outcomes, this has been a successful policy.

In terms of whether the policy has had any overall effect, the policy evaluation regressions revealed that it is only in the poorer LEAs that there are identifiable policy effects – so the areas that the Government targeted ***were*** affected by the policy's introduction.

Though the policy increased provision for 3-year olds in the non-schools sector – comprised largely of private sector places – there were no measured robust effects of this increase on results in reading or writing either overall or for either the more or less deprived LEAs when estimated separately. There is slight evidence that increased use of the private sector for 3-year olds' early education actually had a negative effect on results in maths at the higher level for the poorer LEAs but a positive effect on the level children are expected to attain in the better off LEAs.

My main finding is that there is a small but significant and robust positive effect of take-up of free early education places in maintained nursery and primary schools, by 3-year olds in the poorer LEAs, on the percentage of children attaining level 2B or higher in KS1 reading and writing. Though small in magnitude (approximately one-third of a within standard deviation for a 10%-point increase in take-up), these effects are comparable to reducing average KS1 class size by almost one child in the case of reading, and three-quarters of a child in the case of writing. The results suggest that switching all provision of early education for 3-year olds to maintained school settings rather than private settings would increase results in reading and writing by approximately one standard deviation in the poorer LEAs. Moreover, my findings are in line with the EPPE study which suggests that children attending maintained nursery and primary settings for pre-school perform better on school entry and at age 7.

It is also cautiously concluded that there is a significant and robust positive effect of the take-up of free early education places in maintained nursery and primary schools, by 4-year olds in the better-off LEAs, on the percentage of children attaining level 3 or higher in KS1 reading, writing and maths. The effects are still small in absolute terms but for a take-up increase of 10%-points, represent increases of three-quarters of a within standard deviation (reading), half of a within standard deviation (writing) and one third of a within standard deviation (maths). Given that the majority of 4-year olds attending a free early education place in a maintained nursery or primary school are actually attending a reception or infant class in a primary school, the results here suggest that, in the better off LEAs, increasing the proportion of children who start primary school early has a positive effect on KS1 results increasing the percentage of children who exceed expected levels of attainment. However this "result" is only tentative due to concerns over an upward bias in the estimated coefficient.

In terms of educational outcomes, the magnitude of the effect of increasing provision of free places for 3-year olds is small, even in maintained settings, suggesting that improving results may not be a justification for such universal provision. However, there are other externalities associated with early education that need to be considered. These include behavioural and socialisation gains from early education, and the development of non-cognitive skills that then facilitate learning and allow children to make the most of the education that they receive and the natural abilities that they have been endowed with. Moreover, there are wider benefits accruing to children, parents and society as a whole, as a result of parents – particularly

single parents – being aided in returning to the labour market as a result of the free early education places policy, in conjunction with other policies such as the childcare element of the working tax credit.

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Full Description of Variables in the Tables

3-year olds early education (EE) take-up school (sch) sector (*t*) = percentage of the 3-year old population in the LEA at time *t* that took a free early education place in a maintained nursery school or a nursery or infant class in a maintained primary school.

3-year olds early education (EE) take-up non-school (sch) sector (*t*) = percentage of the 3-year old population in the LEA at time *t* that took a free early education place in with an alternative maintained or private, voluntary or independent provider.

4-year olds early education (EE) take-up school (sch) sector (*t+1*) = percentage of the 3-year old population in the LEA at time *t+1* that took a free early education place in a maintained nursery school or a nursery or infant class in a maintained primary school.

4-year olds early education (EE) take-up non-school (sch) sector (*t+1*) = percentage of the 3-year old population in the LEA at time *t+1* that took a free early education place in with an alternative maintained or private, voluntary or independent provider.

childcare places available: day nursery (dnp) (*t*) = percentage of the 3- and 4-year old population in the LEA at time *t* that could have a place in a day nursery. Day nurseries look after children for up to the full working day.

childcare places available: childminder (cmp) (*t*)= percentage of the 3- and 4-year old population in the LEA at time *t* that could have a place with a childminder. Childminders look after children for up to the full working day.

childcare places available: playgroup (pgp) (*t*) = percentage of the 3- and 4-year old population in the LEA at time *t* that could have a place at a playgroup. Most playgroups run five sessions a week of between 2.5 and 4 hours. If sessions are run morning and afternoon children are only to attend either or.

3-year olds early education (EE) take-up school (sch) sector 'poorer' LEAs (*t*) = percentage of the 3-year old population in the LEA at time *t* that took a free early education place in a maintained nursery school or a nursery or infant class in a maintained primary school, for the first 65 group of LEAs to receive the NEG funding for 3-year olds.

3-year olds early education (EE) take-up school (sch) sector 'better off' LEAs (*t*) = percentage of the 3-year old population in the LEA at time *t* that took a free early education place in a maintained nursery school or a nursery or infant class in a maintained primary school, for the LEAs who were not in the first 65 group of LEAs to receive the NEG funding for 3-year olds.

3-year olds early education (EE) take-up non-school (sch) sector (*t*) = percentage of the 3-year old population in the LEA at time *t* that took a free early education place in with an alternative maintained or private, voluntary or independent provider, for the first 65 group of LEAs to receive the NEG funding for 3-year olds.

3-year olds early education (EE) take-up non-school (sch) sector (*t*) = percentage of the 3-year old population in the LEA at time *t* that took a free early education place in with an alternative maintained or private, voluntary or independent provider, for the LEAs who were not in the first 65 group of LEAs to receive the NEG funding for 3-year olds.

4-year olds early education (EE) take-up school (sch) sector 'poorer' LEAs (*t+1*) = percentage of the 4-year old population in the LEA at time *t+1* that took a free early education place in a maintained nursery school or a nursery or infant class in a maintained primary school, for the first 65 group of LEAs to receive the NEG funding for 3-year olds.

4-year olds early education (EE) take-up school (sch) sector 'better off' LEAs (*t+1*) = percentage of the 4-year old population in the LEA at time *t+1* that took a free early education place in a maintained nursery school or a nursery or infant class in a maintained primary school, for the LEAs who were not in the first 65 group of LEAs to receive the NEG funding for 3-year olds.

4-year olds early education (EE) take-up non-school (sch) sector 'poorer' LEAs (*t+1*) = percentage of the 4-year old population in the LEA at time *t+1* that took a free early education place in with an alternative maintained or private, voluntary or independent provider, for the first 65 group of LEAs to receive the NEG funding for 3-year olds.

4-year olds early education (EE) take-up non-school (sch) sector 'better off' LEAs (*t+1*) = percentage of the 4-year old population in the LEA at time *t+1* that took a free early education place in with an alternative maintained or private, voluntary or independent provider, for the LEAs who were not in the first 65 group of LEAs to receive the NEG funding for 3-year olds.

economic inactivity rate, working age males (*t*) = % of working age males who are economically inactive at time *t*.

manufacturing jobs rate (*t*) = % of total employed who are employed in manufacturing occupations at time *t.*

median weekly gross pay, f-t male workers (*t*) = median weekly gross pay for male full time workers, all industries/occupations at time *t*.

average KS1 class size (*t+3*) = average class size for KS1 classes across the whole LEA at time (*t+3*) when the children take their KS1 assessments.

% of non-white children (*t+3*) = percentage of children in maintained primary schools in the LEA who are of non-white ethnic origin at time (*t+3*) when the children take their KS1 assessments.

#family centres per 10,000 3/4 year olds (*t*) = the number of family centres in the LEA at time t, per 10,000 children aged 3 or 4.

#family centres per 10,000 3/4 year olds 'poorer' LEAs (*t*) = the number of family centres in the LEA at time t, per 10,000 children aged 3 or 4 for the first 65 group of LEAs to receive the NEG funding for 3-year olds.

#family centres per 10,000 3/4 year olds 'better off' LEAs (*t*) = the number of family centres in the LEA at time t, per 10,000 children aged 3 or 4 for the LEAs who were not in the first 65 group of LEAs to receive the NEG funding for 3-year olds.

Table 1: Summary of Dependent Variables: Sample 1

Variable		Mean	Std. Dev.	Min	Max		Observations			Within Range	
reading L3+	overall	27.00	5.32	14.00	44.00		N	464		Mean	4.77
	between		4.91	15.25	41.00		n	120		Median	5
	within		2.03	18.50	32.25		T-bar	3.87			
reading L2B+	overall	68.83	4.99	53.00	82.00		N	575		Mean	4.06
	between		4.72	55.50	78.20		n	120		Median	4
	within		1.70	64.43	75.43		T-bar	4.79			
writing L3+	overall	13.23	4.41	1.00	25.00		N	464		Mean	7.12
	between		3.24	6.50	22.00		n	120		Median	7
	within		2.99	2.98	18.73		T-bar	3.87			
writing L2B+	overall	59.55	5.52	44.00	72.00		N	575		Mean	5.1
	between		5.13	45.75	69.60		n	120		Median	5
	within		2.10	53.15	66.15		T-bar	4.79			
maths L3+	overall	26.68	6.12	11.00	43.00		N	464		Mean	10.06
	between		4.54	16.00	38.75		n	120		Median	10
	within		4.09	13.93	34.93		T-bar	3.87			
maths L2B+	overall	73.82	4.76	58.00	86.00		N	575		Mean	4.58
	between		4.40	61.75	82.80		n	120		Median	4
	within		1.84	67.22	79.22		T-bar	4.79			

Note: the within figures for minimum and maximum have the overall mean of the variable added back in to make results comparable.

*subject*_LX = percentage of children in the LEA's maintained schools achieving level X or above in their KS1 *subject* assessment.

subject = {reading, writing, maths}

Table 1(a): Summary of Dependent Variables: Sample 1, separately by first 65 LEAs group membership

	First 65 group of LEAs: 'poorer'										Not First 65 group of LEAs: 'better off'									
Variable		**Mean**	**Std. Dev.**	**Min**	**Max**		**Observations**		**Within Range**			**Mean**	**Std. Dev.**	**Min**	**Max**		**Observations**		**Within Range**	
reading L3+	overall	23.41	4.12	14.00	34.00		N	217	Mean	4.54	overall	30.15	4.12	20.00	44.00		N	247	Mean	4.97
	between		3.71	15.25	30.67		n	56	Median	4	between		3.52	22.75	41.00		n	64	Median	5
	within		1.90	16.16	27.41		T-bar	3.88			within		2.14	21.65	35.40		T-bar	3.86		
reading L2B+	overall	65.68	4.56	53.00	76.00		N	269	Mean	3.88	overall	71.59	3.48	60.00	82.00		N	306	Mean	4.22
	between		4.31	55.50	74.20		n	56	Median	4	between		3.04	64.40	78.20		n	64	Median	4
	within		1.66	61.28	70.88		T-bar	4.80			within		1.73	67.19	78.19		T-bar	4.78		
writing L3+	overall	11.39	3.59	2.00	20.00		N	217	Mean	6.63	overall	14.84	4.45	1.00	25.00		N	247	Mean	7.55
	between		2.30	7.00	17.25		n	56	Median	7	between		3.11	6.50	22.00		n	64	Median	8
	within		2.76	3.89	16.89		T-bar	3.88			within		3.19	4.59	20.34		T-bar	3.86		
writing L2B+	overall	56.30	5.24	44.00	71.00		N	269	Mean	5.32	overall	62.41	3.95	49.00	72.00		N	306	Mean	4.91
	between		4.81	45.75	66.80		n	56	Median	5	between		3.44	53.60	69.60		n	64	Median	4
	within		2.19	49.90	61.50		T-bar	4.80			within		2.01	56.21	69.01		T-bar	4.78		
maths L3+	overall	23.50	5.34	11.00	36.00		N	217	Mean	10.09	overall	29.48	5.34	14.00	43.00		N	247	Mean	10.03
	between		3.54	16.00	31.50		n	56	Median	10	between		3.38	23.00	38.75		n	64	Median	10
	within		4.03	11.50	30.50		T-bar	3.88			within		4.15	16.73	37.73		T-bar	3.86		
maths L2B+	overall	70.79	4.49	58.00	81.00		N	269	Mean	5.07	overall	76.48	3.11	66.00	86.00		N	306	Mean	4.14
	between		4.07	61.75	79.20		n	56	Median	5	between		2.63	68.00	82.80		n	64	Median	4
	within		2.02	64.19	76.19		T-bar	4.80			within		1.66	71.08	81.48		T-bar	4.78		

Note: the within figures for minimum and maximum have the overall mean of the variable added back in to make results comparable.

subject LX = percentage of children in the LEA's maintained schools achieving level X or above in their KS1 *subject* assessment.

subject = {reading, writing, maths}

Graph 1(a): Kernel Density Plots of the Distributions of Dependent Variables First 65 ('poorer') LEAs versus Not-First 65 LEAs

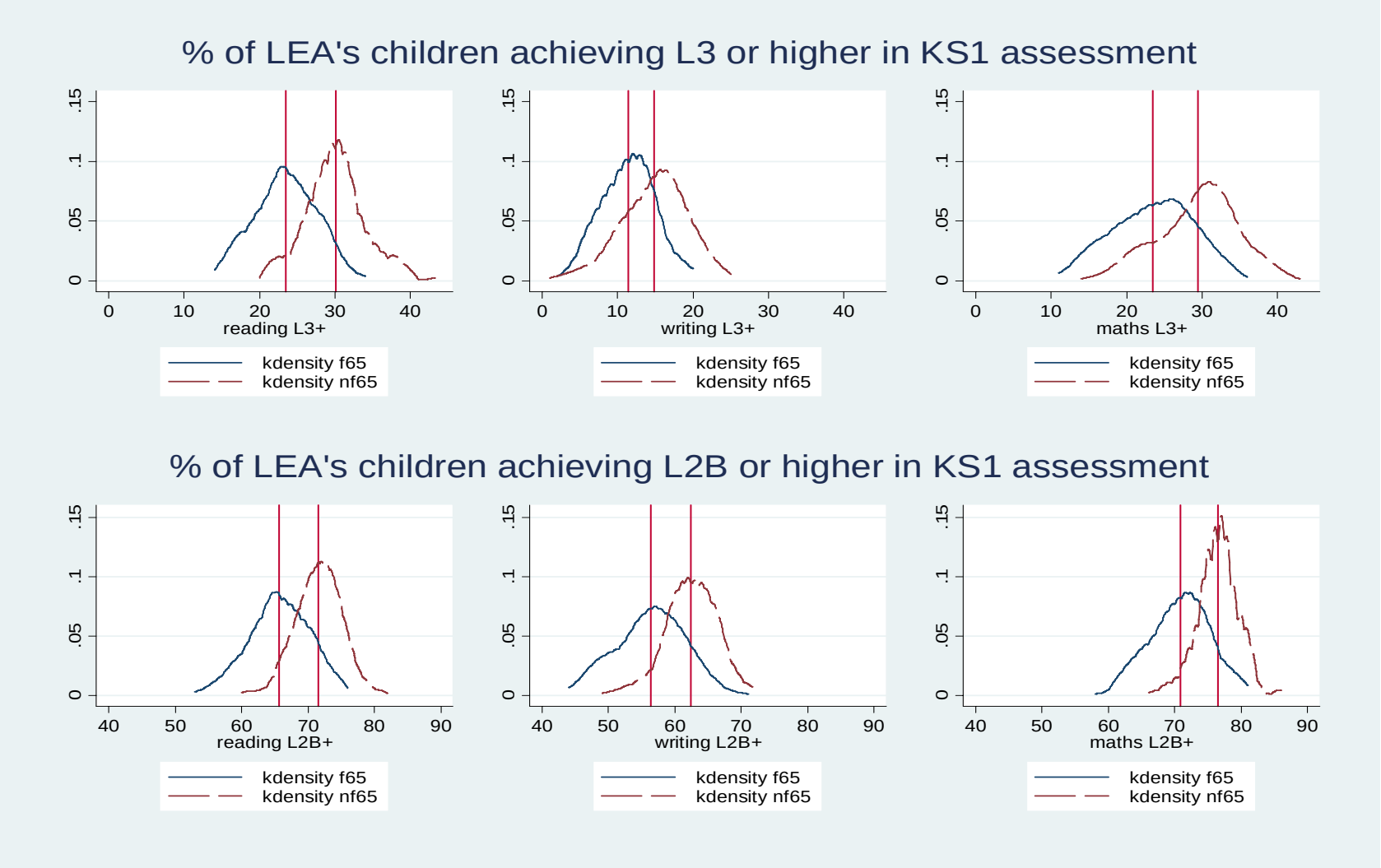


Table 1(b): Summary of Dependent Variables L2B or higher attainment: Sample 1, by year, separately by first 65 LEAs group membership

		Level 2B or higher														
		First 65 group of LEAs: 'poorer'						Not First 65 group of LEAs: 'better off'								
Variable		Obs	Mean	Std. Dev.	Min	Max		Variable	Obs	Mean	Std. Dev.	Min	Max		Difference in means		
reading L2B+	2001	52	65.06	4.75	53	75		reading L2B+	59	70.47	3.33	62	78		reading L2B+	2001	5.42
	2002	55	64.84	4.62	54	74			62	70.53	3.27	60	77			2002	5.70
	2003	54	65.02	4.44	53	74			60	71.00	3.11	61	76			2003	5.98
	2004	53	66.42	4.55	55	75			61	72.48	3.49	65	80			2004	6.06
	2005	54	68.31	4.27	60	76			63	74.60	3.14	67	81			2005	6.29
	2006	55	67.07	4.14	60	76			64	73.38	3.29	67	82			2006	6.30
writing L2B+	2001	52	54.58	5.44	44	68		writing L2B+	59	60.51	3.94	49	68		writing L2B+	2001	5.93
	2002	55	55.29	5.23	44	66			62	61.65	3.85	50	68			2002	6.35
	2003	54	58.06	5.17	44	71			60	64.02	3.62	54	72			2003	5.96
	2004	53	57.60	4.95	46	69			61	63.36	3.92	52	71			2004	5.76
	2005	54	57.56	4.96	47	69			63	64.14	3.72	56	74			2005	6.59
	2006	55	55.98	4.76	46	65			64	62.50	3.57	56	71			2006	6.52
maths L2B+	2001	52	72.35	4.00	64	81		maths L2B+	59	77.20	2.69	67	82		maths L2B+	2001	4.86
	2002	55	72.11	4.19	63	80			62	77.37	2.59	70	83			2002	5.26
	2003	54	69.56	4.40	58	78			60	75.47	2.82	66	81			2003	5.91
	2004	53	71.45	4.41	63	80			61	77.18	3.44	69	86			2004	5.73
	2005	54	70.26	4.65	62	82			63	76.41	3.00	68	84			2005	6.15
	2006	55	68.58	4.33	62	78			64	75.23	3.25	68	82			2006	6.65

subject LX = percentage of children in the LEA's maintained schools achieving level X or above in their KS1 *subject* assessment.

subject = {reading, writing, maths}

Table 1(c): Summary of Dependent Variables L3 or higher attainment: Sample 1, by year, separately by first 65 LEAs group membership

	Level 3 or higher																
		First 65 group of LEAs: 'poorer'							Not First 65 group of LEAs: 'better-off'								
Variable		Obs	Mean	Std. Dev.	Min	Max		Variable	Obs	Mean	Std. Dev.	Min	Max		Difference in means		
reading L3+	2002	55	25.38	4.24	16	34		reading L3+	62	32.29	3.87	22	44		reading L3+	2002	6.91
	2003	54	23.48	3.98	14	31			60	30.18	3.45	22	39			2003	6.70
	2004	53	23.77	3.57	15	30			61	30.48	3.74	22	44			2004	6.70
	2005	54	22.48	4.18	14	32			63	29.46	3.71	21	39			2005	6.98
	2006	55	21.04	3.52	14	28			64	27.75	4.09	20	39			2006	6.71
writing L3+	2002	55	7.45	2.46	2	13		writing L3+	62	10.23	3.51	1	16		writing L3+	2002	2.77
	2003	54	13.69	2.93	9	20			60	17.22	3.73	6	25			2003	3.53
	2004	53	13.21	2.70	7	19			61	16.67	3.39	7	24			2004	3.46
	2005	54	12.69	2.86	7	20			63	16.59	3.19	11	29			2005	3.90
	2006	55	11.31	2.37	7	18			64	15.34	3.39	9	25			2006	4.03
maths L3+	2002	55	27.69	3.76	21	36		maths L3+	62	33.13	3.30	26	43		maths L3+	2002	5.44
	2003	54	25.02	4.13	16	33			60	31.48	3.68	21	40			2003	6.46
	2004	53	23.81	3.96	15	32			61	30.23	3.96	22	40			2004	6.42
	2005	54	19.07	4.02	12	27			63	25.13	3.89	18	35			2005	6.05
	2006	55	17.51	3.37	11	25			64	23.34	4.21	14	36			2006	5.83

subject LX = percentage of children in the LEA's maintained schools achieving level X or above in their KS1 *subject* assessment.

subject = {reading, writing, maths}

Table 2: Summary of Independent Variables: Sample 1

Variable		Mean	Std. Dev.	Min	Max		Observations		Within Range	
3-year olds early education take-up,	overall	43.09	24.17	1.02	104.26	N	575		Mean	6.41
schools sector	between		23.89	1.40	101.34	n	120		Median	4.37
	within		3.62	18.50	73.07	T-bar	4.79			
3-year olds early education take-up,	overall	12.89	17.52	0.00	74.53	N	575		Mean	35.72
non-schools sector	between		6.11	1.68	27.38	n	120		Median	35.31
	within		16.42	-14.49	66.41	T-bar	4.79			
4-year olds early education take-up,	overall	81.71	11.99	43.38	108.65	N	575		Mean	5.02
schools sector	between		11.80	49.55	101.87	n	120		Median	4.37
	within		2.12	73.73	92.08	T-bar	4.79			
4-year olds early education take-up,	overall	15.36	10.31	0.00	50.17	N	575		Mean	6.03
non-schools sector	between		9.96	0.65	44.77	n	120		Median	4.99
	within		2.69	3.62	27.03	T-bar	4.79			
childcare places available: day nursery	overall	9.20	4.11	0.00	28.00	N	575		Mean	6.68
	between		3.12	3.23	17.41	n	120		Median	6.6
	within		2.69	-0.82	20.29	T-bar	4.79			
childcare places available: childminder	overall	10.22	4.47	1.94	29.58	N	575		Mean	3.24
	between		4.16	2.39	26.65	n	120		Median	2.43
	within		1.56	-0.19	20.18	T-bar	4.79			
childcare places available: playgroup	overall	24.41	12.07	3.59	62.98	N	575		Mean	8.45
	between		11.41	6.53	52.81	n	120		Median	6.84
	within		3.95	2.22	39.72	T-bar	4.79			

Note: the within figures for minimum and maximum have the overall mean of the variable added back in to make results comparable.

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

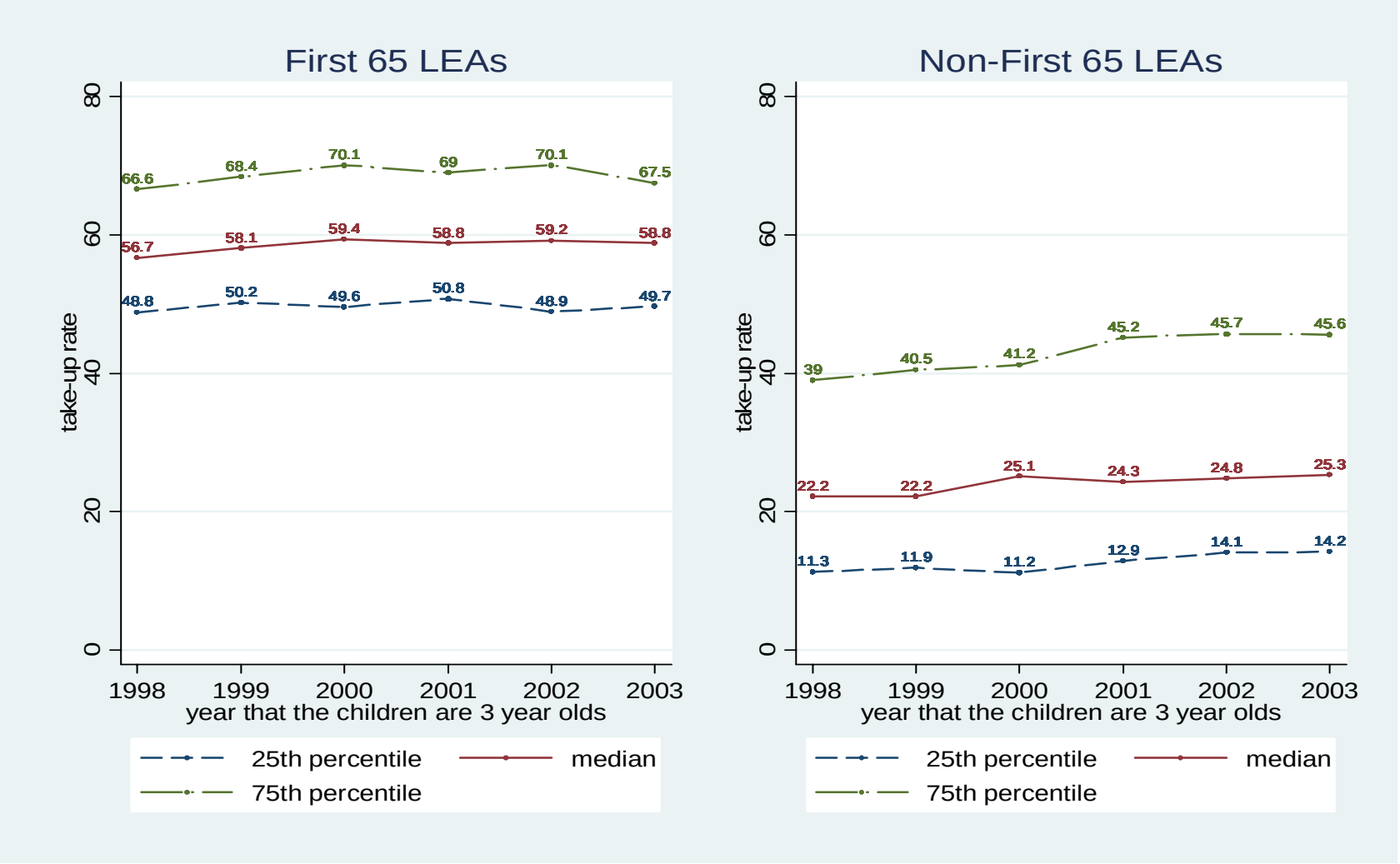
Table 2(a): Summary of Independent Variables: Sample 1, separately by first 65 LEAs group membership

	First 65 group of LEAs: 'poorer' LEAs										Not First 65 group of LEAs: 'better off' LEAs									
Var		**Mean**	**Std. Dev.**	**Min**	**Max**		**Observations**		**Within Range**			**Mean**	**Std. Dev.**	**Min**	**Max**		**Observations**		**Within Range**	
3-year olds, schools sector	overall	59.39	16.70	8.83	104.26		N	269	Mean	6.96	overall	28.77	20.34	1.02	104.02		N	306	Mean	5.92
	between		16.55	9.38	96.03		n	56	Median	5.06	between		20.41	1.40	101.34		n	64	Median	3.80
	within		3.25	34.79	76.76		T-bar	4.80			within		3.93	6.43	58.75		T-bar	4.78		
3-year olds, non-schools sector	overall	13.85	15.01	0.00	69.82		N	269	Mean	28.79	overall	12.05	19.44	0.00	74.53		N	306	Mean	41.79
	between		6.66	2.39	27.38		n	56	Median	30.66	between		5.49	1.68	25.34		n	64	Median	43.71
	within		13.45	-13.54	56.29		T-bar	4.80			within		18.66	-13.29	65.57		T-bar	4.78		
4-year olds, schools sector	overall	88.08	9.22	60.35	108.65		N	269	Mean	5.37	overall	76.10	11.33	43.38	104.86		N	306	Mean	4.71
	between		9.02	63.53	101.84		n	56	Median	4.89	between		11.28	49.55	101.87		n	64	Median	4.20
	within		2.23	81.62	98.45		T-bar	4.80			within		2.02	68.12	82.24		T-bar	4.78		
4-year olds, non-schools sector	overall	9.69	7.68	0.00	34.42		N	269	Mean	5.79	overall	20.36	9.75	0.00	50.17		N	306	Mean	6.24
	between		7.35	0.99	31.92		n	56	Median	4.79	between		9.41	0.65	44.77		n	64	Median	5.20
	within		2.52	2.31	21.36		T-bar	4.80			within		2.83	8.61	31.21		T-bar	4.78		
dnp	overall	8.83	4.12	0.65	28.00		N	269	Mean	6.12	overall	9.52	4.07	0.00	22.22		N	306	Mean	7.17
	between		3.20	3.23	17.41		n	56	Median	5.56	between		3.03	3.31	15.25		n	64	Median	6.95
	within		2.59	-1.19	19.92		T-bar	4.80			within		2.78	1.79	17.19		T-bar	4.78		
cmp	overall	8.04	3.19	1.94	20.29		N	269	Mean	2.74	overall	12.13	4.55	1.98	29.58		N	306	Mean	3.68
	between		2.93	2.79	15.16		n	56	Median	1.99	between		4.17	2.39	26.65		n	64	Median	2.82
	within		1.30	2.40	18.01		T-bar	4.80			within		1.75	1.73	19.55		T-bar	4.78		
pgp	overall	16.65	8.72	3.92	58.99		N	269	Mean	6.84	overall	31.22	10.38	3.59	62.98		N	306	Mean	9.86
	between		8.43	6.53	52.35		n	56	Median	5.87	between		9.29	13.04	52.81		n	64	Median	8.73
	within		3.08	3.95	30.66		T-bar	4.80			within		4.58	9.04	46.54		T-bar	4.80		

Note: the within figures for minimum and maximum have the overall mean of the variable added back in to make results comparable.

Key: variables as Table D2: 3-(4-)year olds, (non-) schools sector = 3-(4-)year olds early education take-up, (non-) schools sector.
dnp = childcare places available: day nursery; cmp = childcare places available: childminder; pgp = childcare places available: playgroup.
See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Graph 2(a): Percentiles of the Take-Up Rate of Free Early Education Places by 3-year olds in Maintained Nursery and Primary Schools



Graph 2(b): Percentiles of the Take-Up Rate of Free Early Education Places by 3-year olds in the 'Other' Sector Settings

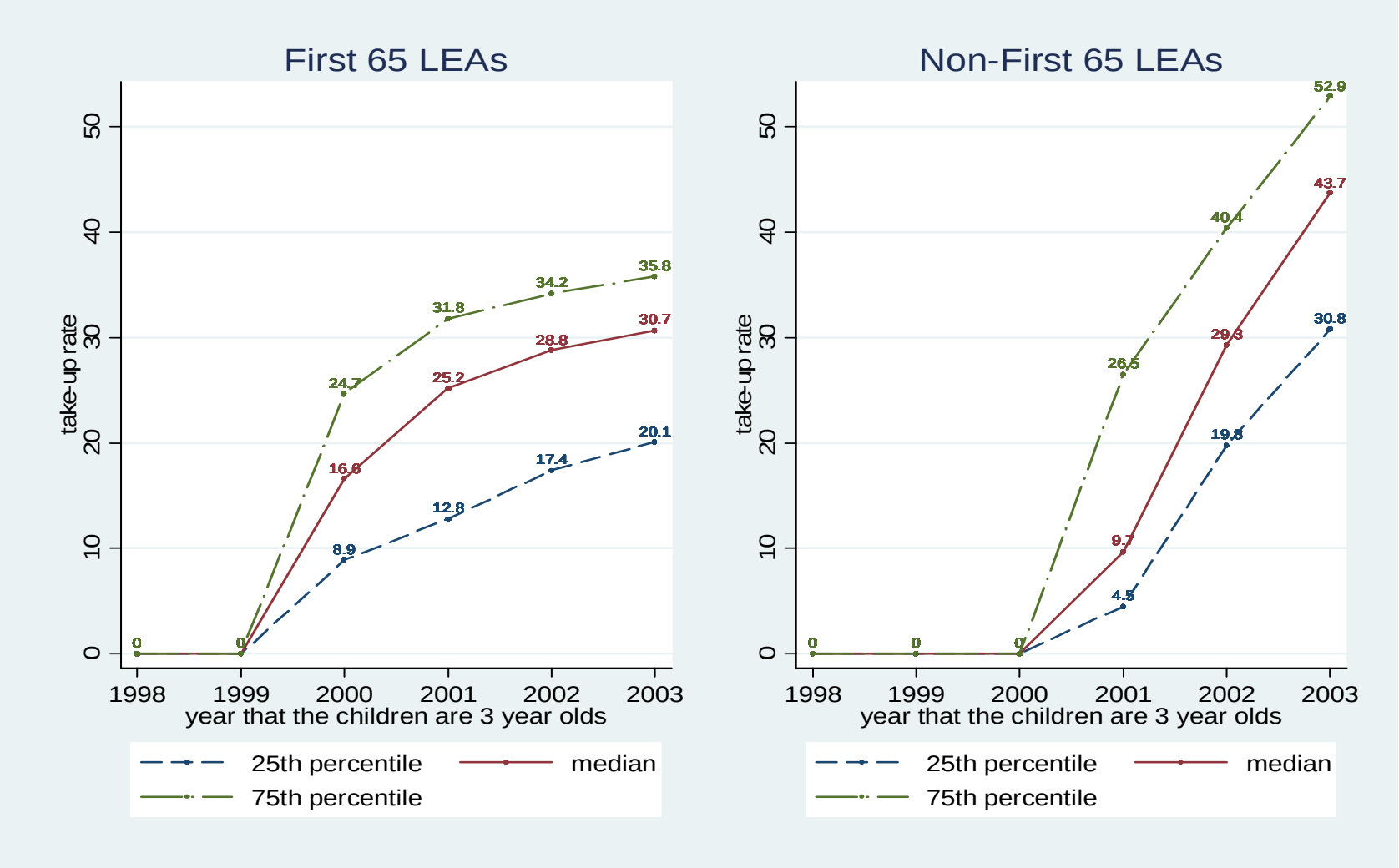


Table 3: Summary of Additional Independent Variables: Sample 1

Variable		Mean	Std. Dev.	Min	Max		Observations			Within Range	
economic inactivity rate,	overall	16.14	5.55	0.00	40.10		N	575		Mean	7.12
working age males	between		4.74	6.11	29.33		n	120		Median	6.64
	within		2.93	6.68	26.90		T-bar	4.79			
manufacturing jobs rate	overall	16.54	6.70	1.81	41.01		N	575		Mean	6.02
	between		6.22	3.53	33.26		n	120		Median	5.48
	within		2.50	5.14	29.90		T-bar	4.79			
median weekly gross pay,	overall	405.11	63.13	266.10	679.00		N	575		Mean	72.53
f-t male workers	between		56.23	303.06	610.48		n	120		Median	70.75
	within		28.57	306.15	519.55		T-bar	4.79			
average KS1 class size	overall	25.64	1.15	22.90	28.30		N	575		Mean	1.38
	between		1.01	23.66	27.88		n	120		Median	1.30
	within		0.55	24.06	28.10		T-bar	4.79			
% of non-white children	overall	18.51	21.36	0.00	80.91		N	574		Mean	4.81
	between		21.16	0.94	77.47		n	120		Median	3.79
	within		2.22	8.93	29.43		T-bar	4.78			

Note: the within figures for minimum and maximum have the overall mean of the variable added back in to make results comparable.

Key:
economic inactivity rate, working age males = % of working age males who are economically inactive

manufacturing jobs rate = % of total employed who are employed in manufacturing occupations

median weekly gross pay, f-t male workers = median weekly gross pay for male full time workers, all industries/occupations, £s

average KS1 class size = average class size for KS1 classes across the whole LEA

% of non-white children = percentage of children in maintained primary schools in the LEA who are of non-white ethnic origin

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 3(a): Summary of Additional Independent Variables: Sample 1, separately by first 65 LEAs group membership

	First 65 group of LEAs: 'poorer' LEAs										Not First 65 group of LEAs: 'better off' LEAs									
Var		**Mean**	**Std. Dev.**	**Min**	**Max**		**Observations**			**Within Range**		**Mean**	**Std. Dev.**	**Min**	**Max**		**Observations**			**Within Range**
econ inac rate	overall	19.66	4.81	8.58	40.10		N	269		Mean 8.42	overall	13.05	4.15	0.00	35.49		N	306		Mean 5.99
	between		3.51	12.77	29.33		n	56		Median 8.12	between		3.38	6.11	24.96		n	64		Median 5.61
	within		3.31	10.20	30.42		T-bar	4.80			within		2.56	4.94	23.58		T-bar	4.78		
manuf. jobs rate	overall	16.79	7.50	3.10	41.01		N	269		Mean 6.37	overall	16.32	5.92	1.81	32.49		N	306		Mean 5.71
	between		7.06	6.78	33.26		n	56		Median 6.28	between		5.42	3.53	27.37		n	64		Median 5.08
	within		2.53	8.61	24.54		T-bar	4.80			within		2.48	4.92	29.68		T-bar	4.78		
m week pay gross	overall	406.89	72.02	283.40	679.00		N	269		Mean 69.38	overall	403.54	54.20	266.10	577.10		N	306		Mean 75.30
	between		66.20	313.62	610.48		n	56		Median 62.65	between		46.31	303.06	526.82		n	64		Median 76.45
	within		28.40	307.93	521.33		T-bar	4.80			within		28.77	344.72	480.82		T-bar	4.78		
av. KS1 class size	overall	25.65	1.13	22.90	28.30		N	269		Mean 1.36	overall	25.63	1.16	22.90	28.00		N	306		Mean 1.40
	between		1.01	23.66	27.88		n	56		Median 1.30	between		1.03	23.66	27.40		n	64		Median 1.30
	within		0.53	24.53	27.35		T-bar	4.80			within		0.57	24.05	28.09		T-bar	4.78		
% non-white	overall	27.38	25.05	0.78	80.91		N	268		Mean 5.64	overall	10.75	13.36	0.00	64.69		N	306		Mean 4.08
	between		25.07	1.25	77.47		n	56		Median 5.53	between		13.12	0.94	58.64		n	64		Median 3.11
	within		2.50	19.74	38.30		T-bar	4.79			within		1.95	1.16	17.96		T-bar	4.78		

Note: the within figures for minimum and maximum have the overall mean of the variable added back in to make results comparable.

Key: variables as Table D3:
econ inac rate = economic inactivity rate, working age males: % of working age males who are economically inactive

manuf. jobs rate = manufacturing jobs rate: % of total employed who are employed in manufacturing occupations

m week gross pay = median weekly gross pay for male full time workers, all industries/occupations, £s

av. KS1 class size = average class size for KS1 classes across the whole LEA

% non-white = percentage of children in maintained primary schools in the LEA who are of non-white ethnic origin

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 4: The Effect of Free Early Education Place Policy on Reading Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	#1	#2	#1	#2
policy (*t*)	-0.007		0.184	
	0.276		0.235	
policy first-65 LEAs (*t*)		-0.156		**0.425#**
		0.320		0.266
policy not first-65 LEAs (*t*)		0.138		0.062
		0.336		0.301
year=2002	-0.128	-0.129		
	0.162	0.162		
year=2003	0.119	0.189	**-2.208*** **	**-2.322*** **
	0.239	0.228	0.174	0.182
year=2004	**1.791*** **	**1.783*** **	**-1.784*** **	**-1.833*** **
	0.317	0.319	0.287	0.277
year=2006	**2.471*** **	**2.463*** **	**-4.587*** **	**-4.635*** **
	0.354	0.355	0.317	0.312
constant	**67.969*** **	**67.969*** **	**29.046*** **	**29.046*** **
	0.140	0.140	0.112	0.112
R-sq within	0.397	0.398	0.610	0.611
R-sq between	0.000	0.109	0.013	0.233
R-sq overall	0.045	0.065	0.083	0.058
rho	0.910	0.908	0.917	0.919
#obs	575	575	464	464
#groups	120	120	120	120
LEA level fixed effects included	Yes	Yes	Yes	Yes
Robust Standard Errors, lower figure	rho is the fraction of the variance due to the fixed effects			
* p<0.10, ** p<0.05, *** p<0.01	# p=0.112			

Notes:
Model #1: common policy effect
Model #2: allowing for different effects of policy in the 'poorer' and in the 'better-off' LEAs.
Interpretation of the coefficients: The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 reading. The estimated coefficient on the policy dummy in the first-65 LEAs for level 3 or higher of 0.425 suggests that the introduction of the free early education place policy in these LEAs is associated with a 0.425%-point increase in the percentage of children in the LEA attaining level 3 or higher in reading at KS1.

Table 5: The Effect of Free Early Education Place Policy on Writing Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	#1	#2	#1	#2
policy (*t*)	0.255		-0.057	
	0.362		0.325	
policy first-65 LEAs (*t*)		0.422		**-0.728#**
		0.447		0.448
policy not first-65 LEAs (*t*)		0.093		0.282
		0.413		0.342
year=2002	**0.885*** **	**0.885*** **		
	0.212	0.212		
year=2003	**3.221*** **	**3.143*** **	**6.625*** **	**6.941*** **
	0.310	0.315	0.292	0.335
year=2004	**2.804*** **	**2.813*** **	**6.268*** **	**6.403*** **
	0.407	0.406	0.396	0.406
year=2006	**1.454*** **	**1.463*** **	**4.612*** **	**4.746*** **
	0.459	0.460	0.413	0.423
constant	**57.752*** **	**57.752*** **	**8.911*** **	**8.909*** **
	0.166	0.166	0.155	0.152
R-sq within	0.355	0.356	0.760	0.764
R-sq between	0.001	0.069	0.007	0.187
R-sq overall	0.047	0.032	0.353	0.410
rho	0.880	0.882	0.780	0.765
#obs	575	575	464	464
#groups	120	120	120	120
LEA level fixed effects included	Yes	Yes	Yes	Yes
Robust Standard Errors, lower figure	rho is the fraction of the variance due to the fixed effects			
* p<0.10, ** p<0.05, *** p<0.01	# p=0.107			

Notes:
Model #1: common policy effect
Model #2: allowing for different effects of policy in the 'poorer' and in the 'better-off' LEAs.
Interpretation of the coefficients: The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 writing. The estimated coefficient on the policy dummy in the first-65 LEAs for level 3 or higher of -0.728 suggests that the introduction of the free early education place policy in these LEAs is associated with a 0.728%-point decrease in the percentage of children in the LEA attaining level 3 or higher in writing at KS1.

Table 6: The Effect of Free Early Education Place Policy on Maths Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	#1	#2	#1	#2
policy (*t*)	-0.250		-0.469	
	0.285		0.346	
policy first-65 LEAs (*t*)		**-0.722****		**-0.825****
		0.331		0.407
policy not first-65 LEAs (*t*)		0.205		-0.289
		0.330		0.389
year=2002	-0.110	-0.111		
	0.159	0.159		
year=2003	**-2.265*****	**-2.045*****	**-2.002*****	**-1.834*****
	0.213	0.224	0.251	0.290
year=2004	-0.149	-0.173	**-2.803*****	**-2.731*****
	0.350	0.346	0.422	0.425
year=2006	**-2.605*****	**-2.630*****	**-9.516*****	**-9.445*****
	0.372	0.365	0.447	0.452
constant	**74.984*****	**74.985*****	**30.592*****	**30.591*****
	0.131	0.128	0.138	0.137
R-sq within	0.438	0.451	0.841	0.842
R-sq between	0.002	0.284	0.016	0.185
R-sq overall	0.068	0.138	0.384	0.412
rho	0.889	0.884	0.849	0.842
#obs	575	575	464	464
#groups	120	120	120	120
LEA level fixed effects included	Yes	Yes	Yes	Yes
Robust Standard Errors, lower figure	rho is the fraction of the variance due to the fixed effects			
* p<0.10, ** p<0.05, *** p<0.01				

Notes:
Model #1: common policy effect
Model #2: allowing for different effects of policy in the 'poorer' and in the 'better-off' LEAs.
Interpretation of the coefficients: The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 maths. The estimated coefficient on the policy dummy in the first-65 LEAs for level 3 or higher of -0.825 suggests that the introduction of the free early education place policy in these LEAs is associated with a 0.825%-point decrease in the percentage of children in the LEA attaining level 3 or higher in maths at KS1.

Table 7: The Effect of Free Early Education Place Policy on Reading Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	Coeff.	Rob. St. Err.	Coeff.	Rob. St. Err.
3-year olds early educ take-up, school sector (*t*)	**0.037****	0.017	-0.008	0.031
3-year olds early educ take-up, non-school sector (*t*)	0.000	0.008	0.006	0.009
4-year olds early educ take-up, school sector (*t+1*)	-0.013	0.046	0.055	0.043
4-year olds early educ olds take-up, non-school sector (*t+1*)	-0.001	0.023	0.023	0.026
childcare places available: day nursery (*t*)	0.015	0.037	0.010	0.039
childcare places available: childminder (*t*)	0.052	0.049	-0.035	0.043
childcare places available: playgroup (*t*)	-0.011	0.017	-0.014	0.020
average KS1 class size (*t+3*)	**-0.651*****	0.161	**-0.765*****	0.169
year=2002	-0.168	0.163		
year=2003	0.230	0.213	**-1.959*****	0.158
year=2004	**1.969*****	0.267	**-1.444*****	0.253
year=2006	**2.895*****	0.458	**-4.062*****	0.426
constant	**83.634*****	5.509	**44.596*****	5.930
R-sq within	0.432		0.641	
R-sq between	0.007		0.011	
R-sq overall	0.012		0.049	
rho	0.919		0.926	
#obs	575		464	
#groups	120		120	
LEA level fixed effects included	Yes		Yes	
rho is the fraction of the variance due to the fixed effects				
* p<0.10, ** p<0.05, *** p<0.01				

Notes: Interpretation of the coefficients: the key independent variables, 3-year olds and 4-year olds take-up rate of free early education places in school and non-school sectors, are take-up rates expressed as percentages. The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 reading. The estimated coefficient on 3-year olds' take-up of free early education places in the school sector of 0.037 suggests that a 10%-point increase in the percentage of 3-year olds taking a free place in a school setting is associated with a 0.37%-point increase in the percentage of children in the LEA attaining level 2B or higher in reading at KS1.

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 8: The Effect of Free Early Education Place Policy on Writing Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	Coeff.	Rob. St. Err.	Coeff.	Rob. St. Err.
3-year olds early educ take-up, school sector (*t*)	0.011	0.019	0.012	0.024
3-year olds early educ take-up, non-school sector (*t*)	0.010	0.010	0.010	0.009
4-year olds early educ take-up, school sector (*t+1*)	-0.017	0.048	0.047	0.054
4-year olds early educ olds take-up, non-school sector (*t+1*)	0.012	0.029	-0.030	0.030
childcare places available: day nursery (*t*)	0.010	0.045	0.055	0.044
childcare places available: childminder (*t*)	-0.072	0.058	-0.037	0.063
childcare places available: playgroup (*t*)	-0.005	0.019	-0.036	0.023
average KS1 class size (*t+3*)	**-0.943*****	0.217	**-0.456****	0.183
year=2002	**0.830*****	0.229		
year=2003	**3.413*****	0.316	**6.542*****	0.273
year=2004	**3.090*****	0.371	**6.069*****	0.333
year=2006	**2.040*****	0.631	**4.218*****	0.504
constant	**83.215*****	6.441	**17.426****	6.977
R-sq within	0.398		0.770	
R-sq between	0.003		0.051	
R-sq overall	0.052		0.187	
rho	0.886		0.838	
#obs	575		464	
#groups	120		120	
LEA level fixed effects included	Yes		Yes	
rho is the fraction of the variance due to the fixed effects				
* p<0.10, ** p<0.05, *** p<0.01				

Notes: Interpretation of the coefficients: the key independent variables, 3-year olds and 4-year olds take-up rate of free early education places in school and non-school sectors, are take-up rates expressed as percentages. The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 writing. The estimated coefficient on 3-year olds' take-up of free early education places in the non-school sector of 0.010 suggests that a 10%-point increase in the percentage of 3-year olds taking a free place in a non-school setting is associated with a 0.1%-point increase in the percentage of children in the LEA attaining level 2B or higher in writing at KS1 (though it is not a statistically significant result).

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 9: The Effect of Free Early Education Place Policy on Maths Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	Coeff.	Rob. St. Err.	Coeff.	Rob. St. Err.
3-year olds early educ take-up, school sector (*t*)	-0.013	0.024	-0.018	0.032
3-year olds early educ take-up, non-school sector (*t*)	0.010	0.009	-0.004	0.012
4-year olds early educ take-up, school sector (*t+1*)	0.010	0.039	0.070	0.047
4-year olds early educ olds take-up, non-school sector (*t+1*)	-0.025	0.026	-0.018	0.029
childcare places available: day nursery (*t*)	-0.029	0.038	0.027	0.050
childcare places available: childminder (*t*)	0.054	0.049	0.034	0.069
childcare places available: playgroup (*t*)	-0.020	0.017	-0.002	0.028
average KS1 class size (*t+3*)	**-0.348****	0.166	**-0.697*****	0.168
% of non-white children (*t+3*)	**-0.129*****	0.046	-0.005	0.085
year=2002	0.037	0.178		
year=2003	**-1.964*****	0.226	**-1.977*****	0.289
year=2004	0.093	0.317	**-2.886*****	0.425
year=2006	**-2.075*****	0.498	**-9.282*****	0.641
constant	**86.098*****	4.907	**43.138*****	6.673
R-sq within	0.459		0.846	
R-sq between	0.425		0.012	
R-sq overall	0.433		0.377	
rho	0.825		0.852	
#obs	574		463	
#groups	120		120	
LEA level fixed effects included	Yes		Yes	
rho is the fraction of the variance due to the fixed effects				
* p<0.10, ** p<0.05, *** p<0.01				

Notes: Interpretation of the coefficients: the key independent variables, 3-year olds and 4-year olds take-up rate of free early education places in school and non-school sectors, are take-up rates expressed as percentages. The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 maths. The estimated coefficient on 3-year olds' take-up of free early education places in the non-school sector of 0.010 suggests that a 10%-point increase in the percentage of 3-year olds taking a free place in a non-school setting is associated with a 0.1%-point increase in the percentage of children in the LEA attaining level 2B or higher in maths at KS1 (though it is not a statistically significant result).

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 10: The Effect of Free Early Education Place Policy on Reading Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	Coeff.	Rob. St. Err	Coeff.	Rob. St. Err
3-year olds EE take-up, sch sector 'poorer' LEAs (*t*)	**0.059****	0.024	0.033	0.043
3-year olds EE take-up, sch sector 'better-off' LEAs (*t*)	0.037	0.023	-0.024	0.037
3-year olds EE take-up, non-sch sector 'poorer' LEAs (*t*)	-0.013	0.015	0.000	0.012
3-year olds EE take-up, non-sch sector 'better-off' LEAs (*t*)	0.003	0.007	0.003	0.010
4-year olds EE take-up, sch sector 'poorer' LEAs (*t+1*)	-0.005	0.058	-0.055	0.050
4-year olds EE take-up, sch sector 'better-off' LEAs (*t+1*)	-0.021	0.068	**0.159****	0.069
4-year olds EE take-up, non-sch sector 'poorer' LEAs (*t+1*)	0.027	0.038	0.047	0.033
4-year olds EE take-up, non-sch sector 'better-off' LEAs (*t+1*)	0.000	0.028	0.011	0.040
childcare places available: day nursery (*t*)	0.014	0.036	-0.012	0.040
childcare places available: childminder (*t*)	0.060	0.052	-0.020	0.043
childcare places available: playgroup (*t*)	-0.012	0.016	-0.015	0.020
economic inactivity rate, working age males (*t*)	**-0.057****	0.026	-0.031	0.028
manufacturing jobs rate (*t*)	**-0.046***	0.027		
median weekly gross pay, male f-t workers (*t*)			**0.009***	0.005
average KS1 class size (*t+3*)	**-0.668*****	0.164	**-0.779*****	0.166
year=2002	-0.222	0.171		
year=2003	0.248	0.236	**-2.007*****	0.190
year=2004	**1.935*****	0.315	**-1.557*****	0.274
year=2006	**2.843*****	0.524	**-4.220*****	0.510
constant	**85.024*****	5.254	**41.508*****	6.189
R-sq within	0.447		0.655	
R-sq between	0.189		0.453	
R-sq overall	0.053		0.462	
rho	0.941		0.932	
#obs	575		464	
#groups	120		120	
LEA level fixed effects included	Yes		Yes	
rho is the fraction of the variance due to the fixed effects				
* p<0.10, ** p<0.05, *** p<0.01				

Notes: Interpretation of the coefficients: the key independent variables, 3-year olds and 4-year olds take-up rate of free early education places in school and non-school sectors for each type of LEA, are take-up rates expressed as percentages. The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 reading. The estimated coefficient on 'poorer' LEAs' 3-year olds' take-up of free early education places in the school sector of 0.059 suggests that a 10%-point increase in the percentage of 3-year olds taking a free place in a school setting is associated with a 0.59%-point increase in the percentage of children in the LEA attaining level 2B or higher in reading at KS1.

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 11: The Effect of Free Early Education Place Policy on Writing Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	Coeff.	Rob. St. Err.	Coeff.	Rob. St. Err.
3-year olds EE take-up, sch sector 'poorer' LEAs (*t*)	**0.070****	0.031	0.016	0.039
3-year olds EE take-up, sch sector 'better-off' LEAs (*t*)	-0.012	0.020	-0.011	0.028
3-year olds EE take-up, non-sch sector 'poorer' LEAs (*t*)	-0.005	0.017	-0.016	0.015
3-year olds EE take-up, non-sch sector 'better-off' LEAs (*t*)	0.012	0.011	0.011	0.009
4-year olds EE take-up, sch sector 'poorer' LEAs (*t+1*)	-0.056	0.061	-0.008	0.069
4-year olds EE take-up, sch sector 'better-off' LEAs (*t+1*)	0.009	0.073	**0.157****	0.077
4-year olds EE take-up, non-sch sector 'poorer' LEAs (*t+1*)	0.029	0.057	-0.020	0.045
4-year olds EE take-up, non-sch sector 'better-off' LEAs (*t+1*)	0.020	0.033	-0.001	0.039
childcare places available: day nursery (*t*)	0.008	0.045	0.029	0.044
childcare places available: childminder (*t*)	-0.060	0.060	-0.034	0.063
childcare places available: playgroup (*t*)	-0.009	0.019	**-0.039***	0.023
economic inactivity rate, working age males (*t*)	-0.047	0.029		
manufacturing jobs rate (*t*)	-0.061	0.039	**0.082****	0.041
average KS1 class size (*t+3*)	**-0.948*****	0.228	**-0.450****	0.174
year=2002	**0.754*****	0.230		
year=2003	**3.433*****	0.350	**6.890*****	0.330
year=2004	**3.084*****	0.426	**6.582*****	0.406
year=2006	**2.048*****	0.717	**4.927*****	0.598
constant	**84.247*****	6.243	**13.768***	7.005
R-sq within	0.410		0.779	
R-sq between	0.162		0.321	
R-sq overall	0.189		0.396	
rho	0.869		0.894	
#obs	575		464	
#groups	120		120	
LEA level fixed effects included	Yes		Yes	

rho is the fraction of the variance due to the fixed effects
* p<0.10, ** p<0.05, *** p<0.01

Notes: Interpretation of the coefficients: the key independent variables, 3-year olds and 4-year olds take-up rate of free early education places in school and non-school sectors for each type of LEA, are take-up rates expressed as percentages. The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 writing. The estimated coefficient on 'poorer' LEAs' 3-year olds' take-up of free early education places in the school sector of 0.070 suggests that a 10%-point increase in the percentage of 3-year olds taking a free place in a school setting is associated with a 0.70%-point increase in the percentage of children in the LEA attaining level 2B or higher in writing at KS1.

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 12: The Effect of Free Early Education Place Policy on Maths Attainment
Dependent Variable: Percentage of children in the LEA's maintained schools achieving specified level in KS1 assessment, year (*t+3*)
Panel Regression Models, 5 year panel (L2B or higher), 4 year panel (L3 or higher)

	Level 2B or higher		**Level 3 or higher**	
Independent Variable	Coeff.	Rob. St. Err.	Coeff.	Rob. St. Err.
3-year olds EE take-up, sch sector 'poorer' LEAs (*t*)	-0.021	0.037	0.016	0.043
3-year olds EE take-up, sch sector 'better-off' LEAs (*t*)	-0.014	0.034	-0.051	0.039
3-year olds EE take-up, non-sch sector 'poorer' LEAs (*t*)	-0.020	0.014	**-0.025**#	0.015
3-year olds EE take-up, non-sch sector 'better-off' LEAs (*t*)	**0.018****	0.008	-0.003	0.013
4-year olds EE take-up, sch sector 'poorer' LEAs (*t+1*)	-0.022	0.054	-0.014	0.061
4-year olds EE take-up, sch sector 'better-off' LEAs (*t+1*)	0.060	0.049	**0.155****	0.072
4-year olds EE take-up, non-sch sector 'poorer' LEAs (*t+1*)	0.056	0.040	0.029	0.041
4-year olds EE take-up, non-sch sector 'better-off' LEAs (*t+1*)	-0.028	0.029	-0.020	0.047
childcare places available: day nursery (*t*)	-0.033	0.038	0.010	0.050
childcare places available: childminder (*t*)	0.067	0.047	0.050	0.069
childcare places available: playgroup (*t*)	-0.022	0.018	-0.007	0.029
economic inactivity rate, working age males (*t*)	-0.010	0.023	0.028	0.036
manufacturing jobs rate (*t*)	**-0.052***	0.029		
median weekly gross pay, male f-t workers (*t*)			0.005	0.006
average KS1 class size (*t+3*)	**-0.425****	0.164	**-0.726*****	0.170
% of non-white children (*t+3*)	**-0.120*****	0.045	0.005	0.086
year=2002	0.041	0.186		
year=2003	**-1.766*****	0.236	**-1.869*****	0.307
year=2004	0.200	0.340	**-2.819*****	0.432
year=2006	**-2.023*****	0.535	**-9.270*****	0.671
constant	**88.156*****	4.680	**40.709*****	6.550
R-sq within	0.482		0.850	
R-sq between	0.627		0.427	
R-sq overall	0.599		0.575	
rho	0.809		0.825	
#obs	574		463	
#groups	120		120	
LEA level fixed effects included	Yes		Yes	

rho is the fraction of the variance due to the fixed effects
* p<0.10, ** p<0.05, *** p<0.01, # p=0.102

Notes: Interpretation of the coefficients: the key independent variables, 3-year olds and 4-year olds take-up rate of free early education places in school and non-school sectors for each type of LEA, are take-up rates expressed as percentages. The dependent variable is the percentage of children in an LEA's maintained schools attaining the specified level in KS1 maths. The estimated coefficient on 'better-off' LEAs' 3-year olds' take-up of free early education places in the non-school sector of 0.018 suggests that a 10%-point increase in the percentage of 3-year olds taking a free place in a non-school setting is associated with a 0.18%-point increase in the percentage of children in the LEA attaining level 2B or higher in maths at KS1.

See Full Description of Variables in the Tables, page 36-37, for full definition of each variable.

Table 13: Percentage of 4-year olds in nursery or primary school who are in an infant or reception class in a primary school, by Government Office Region and Year*

	1998	1999	2000	2002
ENGLAND	70.41	71.31	72.23	75.01
NORTH EAST	69.51	68.73	69.79	70.65
NORTH WEST	75.16	74.92	75.35	76.93
YORKSHIRE AND THE HUMBER	61.14	61.99	62.11	67.74
EAST MIDLANDS	59.01	60.98	66.08	69.42
WEST MIDLANDS	73.88	73.99	73.91	75.09
EAST OF ENGLAND	66.33	67.98	69.82	75.20
LONDON	61.47	64.29	65.53	68.20
INNER LONDON	60.12	66.09	67.35	68.15
OUTER LONDON	62.28	63.21	64.33	68.23
SOUTH EAST	79.26	79.65	80.19	82.87
SOUTH WEST	88.75	89.37	89.25	89.97

* Data unavailable for 2001 and 2004.

Data Appendix

There is a measurement error issue inherent in the data, owing to the structure of schooling in England and the timing of the collection of the data on the number of children aged 3 and age 4 taking a free early education place. The law states that children attain compulsory school age when they turn 5 years old and must be in full-time schooling from the start of the academic term following their 5th birthday. However, in reality all LEAs operate an admissions policy that sees children begin school either at the start of the academic term or at the start of the academic year during which they will turn 5. Children start in a Reception or an infant class, and will not start Year 1 until the September when they have already reached age 5. Most will have turned 6 by the end of Year 1, and thus the majority of children will have turned 7 by the end of Year 2 when they take their KS1 assessment tests.

The measurement error arises because the school year-group that a child is in, is determined by their age at 31st August. However, the data on children taking free early education places records the children's age in January[31]. This means that children recorded as age 3 and taking a free early education place in January could be in one of two school years. For expositional purposes we can make the simplifying assumption that births are evenly spread throughout the year, in which case two-thirds of the children recorded as age 3 on 1st January (year *t*) will have turned 4 by August 31st of that year, and will therefore be starting Reception class in the September of that year (*t*). They will start Year 1 in the following September (year *t+1*), start Year 2 in the September after that (year *t+2*) and will sit their KS1 assessments in the May of the year following this (year *t+3*). The other one-third of children aged 3 in January will have only just turned 3 in the months from the previous September to December, and so by 31st August (year *t*) will still be 3 and therefore not starting Reception until the following September (year *t+1*) and not start Year 1 until the September after that (year *t+2*) and will not therefore take their KS1 assessments until year *t+4*.

LEAs operate different policies in terms of whether it is the start of the academic year that the child turns 5 or the start of the academic term that the child turns 5 that they are brought into Reception class, however, this does not affect when they will start Year 1. Those that start in the academic term rather than academic year that they turn 5, have potentially fewer terms in Reception class but will start Year 1 when they are age 5 – the number of terms in Reception class adjusts such that children are always age 5 when they start Year 1.

Data from National Statistics[32] shows that in the years of my data (i.e. births in the calendar years 1994-1999) just over two-thirds of annual births in England and Wales were in the first eight months (this is the case for each year bar 1996 in which it was 66.04%)[33]. This implies that, at the aggregate level, for two-thirds of children the link up of 3 years between the year that they are observed as a 3-year old and the year that they take their KS1 assessment will be correct.

This measurement error creates a problem with the accuracy of the estimates of the effect of free early education places on results – because for each year, one-third of the pupils assessed were 3-year olds in the data four years earlier rather than three years earlier. Put another way, approximately one-third of the cohort that we measure as 3-year olds and link to the results data

[31] Children are recorded in January according to their age on 31st December in the previous year.
[32] Birth Statistics, Review of the Registrar General on births and patterns of family building in England and Wales, 2003, National Statistics Series FM1 no. 32, 2004.
[33] Percentages born in the first 8 months: 1994. 67.35%; 1995, 67.18%; 1996, 66.04%; 1997, 67.28%; 1998, 66.85%; 1999, 67.02%.

three years later do not in fact take their assessment until four years after we recorded them as 3-year olds.

The measurement error should not cause a systematic bias in the estimates since it results purely from the distribution of births throughout the calendar year – and as such is should not be correlated with the right-hand side variables. As the take-up of free early education places for 3-year olds changes, this will not cause any change in the proportion of births in the months September to December. Moreover, I assume that within each LEA over time, the distribution of ability does not covary with the change in the take-up of free early education places for 3-year olds, in which case there should not be a systematic bias introduced to the relevant coefficients on the right hand side. It may be the case that the size of the measurement error differs between LEAs, but as long as this is not correlated with the early education place take-up variables, there will not be a systematic bias introduced.

We know that the proportion of births in the first eight months of the year in England and Wales as a whole remains approximately constant (at two-thirds) throughout the time span of births for the children in my panel of data, whilst the provision of free early education places changes – therefore at the aggregate level there is no relationship between the measurement error and key explanatory variables. I make the assumption that this stability of the measurement error is a feature also exhibited at the level of the LEA, such that there is no systematic bias introduced.

Another issue in the data, concerning this time-lag between the free early education and the KS1 assessments, is the possibility of movement between LEAs in the interim. This again potentially creates a measurement error issue. However, again this should not introduce a systematic bias into coefficient estimates, only attenuate the estimate of the causal effect of free early education on KS1 outcomes. If movement between LEAs in the interim between having an early education place as a 3- or 4-year old and taking KS1 assessments aged 7, is correlated with changing take-up of free early education places then this would bias estimates of the effect of free early education places. However, there is no reason to believe that this would be the case – it is not clear why increasing (decreasing) take-up of early education places would lead to *subsequent* movement into or out of a particular LEA. This problem is not something that I can control for given the limitations of the data that I have, thus it is necessary that I assume that movements across LEA boundaries are not correlated with early education take-up. If this assumption is indeed valid then there should not be a systematic bias introduced into the coefficients.

In sum, these measurement error problems should lead not to a systematic bias in the coefficients but to an attenuation bias in the coefficient estimates. As mentioned in the text, given the measurement error in the data I believe that there is an attenuation bias operating, therefore I consider the positive coefficients to be the lower bound of the estimate of the effect (and any negative coefficients to be the upper bound of the estimate of the effect).

Another consideration is that there may also be the possibility that children are recorded taking their free early education place and then go on to attend an independent school and thus do not have their results included when I estimate the effects on results in maintained schools. If children are recorded taking their early education place in the maintained sector but then go to a private or independent school (i.e. a non-maintained school) for their primary education then this will present a measurement error but it should not be an error that is correlated with changes in the explanatory variables – it is not clear why increased (decreased) take-up by 3-year olds of early education places in the maintained sector would lead to more parents choosing to send their child to a non-maintained primary school. Thus the measurement error should not be correlated with this explanatory variable.

However, there may be a problem of systematic measurement error, to the extent that children who attend an independent school for their free early education place stay in the independent sector for their primary education – which possibly could be the case. If this is the case, then increasing take-up by 3-year olds of free early education in the 'other' sector will be correlated with an increased measurement error.

Unfortunately data is not available at the LEA level, on the number of children taking free early education places at independent schools. However, this information is available for England as a whole. From this data, it can be seen that in January 2000, the independent schools account for just 6% of the free early education places taken by 3-year olds in the 'other' sector, which itself accounted for 14.5% of free early education places taken by 3-year olds. Thus in terms of the total number of free early education places taken by 3-year olds, this is less than 1%[34]. The only other years in which the independent schools could provide a free early education places for 3-year olds were 2001 and 2003[35].

In 2001 the independent schools accounted for 5% of free places for 3-year olds taken in the 'other' sector, though this sector had increased to be 35% of the free early education places taken by 3-year olds. This means that in terms of the total number of free early education places taken by 3-year olds, independent schools accounted for 1.7%.

By 2003, the independent schools were providing 6% of the 'other' sector free places taken by 3-year olds, but the sector had increased to account for 56% of the total number of free places taken by 3-year olds. However, this still means independent schools are only accounting for 3.2% of the total number of free early education places taken by 3-year olds.

There is clearly an increase in the use of independent schools in providing free early education places for 3-year olds – this is the Government's policy in action – and this may mean an increase in the use of independent schools for primary education and therefore an increased measurement error correlated with the explanatory take-up variable. However, the relatively small share of the total market this represents suggests this should not present a serious bias problem. Moreover, examination of the pattern for 4-year olds suggests that it is not the case that an increase in children using independent schools for their free early education place as a 3-year old necessarily leads to increased independent school attendance at primary age.

For 4-year olds, the share of free early education places taken in the 'other' sector, and within this, the share taken in independent schools, remain almost constant at approximately 19% and 18% respectively which means that independent schools are accounting for around 3.5% of free early education places taken by 4-year olds, each year.[36] This is important because it reveals that overall the independent schools part of the early education market for 4-year olds is not growing either in terms of its share of the 'other' sector or its share of the free places in total. Therefore this suggests that the measurement error may not be increasing with time, as it is not the case that overall the independent school attendance by 4-year olds is increasing. Secondly, early education for 4-year olds in independent schools is likely to be a stronger predictor of primary education

[34] It is 0.9%, based on figures calculated from "Provision for children under five years of age in England: January 2004 (Final)", National Statistics Statistical First Release for the DfES, SFR 39/2004, October 2004.
[35] It was available in 2002 but I do not use 2002 data due to the missing childcare data.
[36] All of the percentages for 4-year olds can be found in the data appendix, they are calculated from data in the DfES nursery attendance publications.

attendance than 3-year olds attendance in independent schools. As the attendance of 4-year olds in early education in independent schools is not increasing, this suggests that the 3-year olds attending independent schools for a free early education place may not necessarily remain there as 4-year olds – the populations in question are approximately the same size as it is approximately the same children just one year later. Thus as the proportions of 4-year olds in independent schools are not increasing it must be the case that some children are attending independent schools for early education when 3-year olds but not when 4-year olds. This indicates that the measurement error problem, which would lead to systematic bias in coefficients if increasing independent school attendance for early education by 3-year olds led to increased attendance in independent schools for primary education, may not be realised.

There is also a caveat concerning the accuracy of the population data obtained from National Statistics. Usually at the level of the LEA, population figures are aggregated to 5-year age bands, and it is unusual for single year of age population estimates to be released – they are done so only with warning as to their accuracy[37]. In the estimation samples that I use, the smallest population figures are 367 for 3-year olds and 366 for 4-year olds, though the next smallest are 1171 and 1156 respectively. Therefore the cell sizes are almost exclusively greater than 1,000 which I consider to be sufficient to be reliable.

It also needs to be considered that the population statistics provided from National Statistics are estimates of resident populations – which does not necessarily mean that the child will attend a provider in the LEA in which they live. The fact that some residents will not use facilities in their home LEA potentially leads to measurement error in the take-up rates – something that is acknowledged by the DfES themselves when they attempt to compute take-up rates (see "Provision for children under five years of age in England January 2000", National Statistics Bulletin for the DfES, Issue No. 01/01, January 2001). However, this is again not something that I can correct in the data, and it is the case that the majority of pre-school children will attend a place in their own LEA.

Samples

The 1990s saw a number of waves of local government re-organisation in England, the last of which was completed in April 1998, with boundaries remaining constant since then. In parts of the country that still have counties, there is one LEA for each county; elsewhere there is one LEA in each unitary authority, metropolitan district or London borough[38]. As the final changes concluded just after the time of the first year of data that I use, some LEAs are affected. In order to avoid, as far as possible, problems of having to apportion data to new LEAs that did not exist in 1998 or did exist in 1998 but with different boundaries, I have restricted the main estimation sample to 120 of the 150 LEAs in England. Of the 120 in the main sample, 115 were in existence with entirely the same boundaries and jurisdiction for the entire period from 1998-2003. The remaining 5 LEAs[39] were in existence for the entire time period but had their boundaries changed between the 1998 data and subsequent years. For these latter 5 LEAs, though their boundaries are

[37] They cannot be officially termed "National Statistics" as the smaller than usual cell sizes mean that the potential percentage error is larger than is allowed for figures to be declared as "National Statistics". The LEAs that are most likely to be affected by problems of this sort are the smallest LEAs, and these LEAs are much more likely to be excluded from my estimation samples due to other missing data.

[38] The 150 LEAs correspond to 36 Metropolitan Authorities, 33 London boroughs, 47 Unitary Authorities and 34 County Councils.

[39] Cambridgeshire, Kent, Lancashire, Nottinghamshire and Shropshire.

changed, their early education place data and population data refer to the correct geographical areas so this is not a problem.

In addition to the main estimation sample, I robustness check my results by also considering a further sample, which includes an additional 10 LEAs who were either boundary changing LEAs or new LEAs in 1998[40] and therefore do not have the consistent boundaries that the main sample LEAs have. I also consider a further sample of "all observations", in which any observations from an LEA that has all the necessary variables for the regression is included regardless of the unbalancing effect on the panel.

Robustness Checks

As mentioned in the text, there are a number of checks that I perform in order to test the robustness of my results. The robustness checks are:

1. Perform the regressions on the two additional (larger) samples;
2. Exclude the 2006 results year data as in 2006 the assessment method was slightly altered to include the teacher's assessment of each child in each subject rather than just the child's test results;
3. Include 2006 and also exclude the alternative childcare provider places availability (day nursery, childminder, playgroup) which allows the inclusion of data from the missing year 2002 (as it is only the alternative childcare provider places data that is missing in 2002). Thus making it a 6-year panel;

For each model and subject, the results for these alternative specifications are available from the author on request.

[40] Cheshire, Devon, Essex , Blackburn with Darwen, Blackpool, Medway, Nottingham (City), Peterborough (City), Telford and Wrekin, Thurrock.