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ABSTRACT

Free Childcare and Parents' Labour Supply: Is More Better?*

Despite the introduction of childcare subsidies in many countries, the cost of childcare is still thought to hinder parental employment. Many governments are considering increasing the generosity of their childcare subsidies, but the *a priori* effect of such a policy is ambiguous and little is known empirically about its likely impact. This paper compares the effects on parents' labour supply of offering free part-time childcare and of expanding this offer to the whole school day in England using an empirical strategy which, unlike previous studies, exploits both date of birth discontinuities and panel data. We find that the provision of free part-time childcare has little, if any, causal impact on the labour market outcomes of mothers or fathers. Increasing the number of hours of free childcare to cover a full school day, however, leads to significant increases in the labour supply of mothers whose youngest child is eligible, with impacts emerging immediately and increasing over the months following entitlement.

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1. Introduction

Most OECD countries have introduced policies over the last two decades that make childcare cheaper or more readily available, with the aim of increasing parental labour supply and/or promoting child development. Despite these efforts, the cost of childcare is still a big concern for many parents, potentially hindering their labour market attachment. In recent years, these concerns have led several countries to expand the generosity of their childcare subsidies – e.g. by increasing the number of hours of free or subsidised care available – and many others to announce plans to do so.[1] It is therefore of high policy relevance to understand what impacts *extending* current childcare subsidies will have on parental employment.

Although a large literature investigates the impact of childcare subsidies on parental (mostly maternal) labour supply, most studies assess the impact of offering free or subsidised childcare compared with offering nothing. Because the parents affected by extensions of childcare subsidies are likely to differ from those affected by their introduction, and because subsidies are likely to have non-linear effects on parental employment, the existing literature remains limited in its ability to help predict the impact of extending childcare subsidies.

This paper fills this gap by evaluating the impact on parents' labour supply of initially offering pre-school children free, half-day, childcare and then expanding this free offer to the whole of the school day. This allows us to analyse the impact of offering both part-time care (15 hours per week) and full-time care (30 to 35 hours per week), and, by implication, the impact of extending available hours of free childcare from part-time to full-time. Importantly, our analysis evaluates the impact of these policies in the same institutional context (England), over the same time period, and using the same data and empirical strategy, so that the estimated impacts are directly comparable to each other.

To identify the causal effect of free childcare on parental labour supply, we exploit discontinuities arising from date-of-birth cut-offs in entitlement to free part-time and full-time education places. These discontinuities mean that children gain entitlement to free care at different points in the year and at different ages. The discontinuities arise because, in England, children become entitled to a free part-time place at the start of the school term after they turn three (in September, January or April), and because most children are eligible to start full-time school in the September after they turn four.

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[1] For example, in 2002, Sweden passed a major childcare price reform, which lowered further an already highly-subsidized price of childcare, and Norway followed with a similar reform (Lundin et al., 2008). In January 2015, President Obama proposed a $3,000 tax cut per child 3 years old or younger as a way of further helping low-income families in the US who already receive childcare subsidies (www.whitehouse.gov/the-press-office/2015/01/20/remarks-president-state-union-address-january-20-2015). In the UK, the 2016 Childcare Bill expands the existing offer of free childcare for 3 and 4 year olds from 15 to 30 hours per week for working families living in England from September 2017.

This gives us considerable variation in the timing and duration of entitlement to part-time and full-time care by children's birth month, and we provide evidence that these discontinuities are highly relevant for the take-up of formal childcare.

Several papers have used these sorts of discontinuities to estimate the impact of free childcare on labour market outcomes using a regression discontinuity (RD) design. A major difference of our approach is that we use individual-level longitudinal data and can therefore control for the effect of time-invariant parent characteristics on labour supply. In this sense, our approach can be seen as an individual-level difference-in-differences strategy: we compare the change in parents' labour market outcomes as their children's entitlement to free care changes. To our knowledge, our paper is the first in this area to adopt such a strategy, meaning our results should have stronger internal validity than those exploiting date-of-birth discontinuities with cross-sectional data, or those relying on potentially more endogenous policy rollouts.

We are also able to investigate how the impact of childcare subsidies changes with the duration of entitlement, allowing us to draw a rich picture of the dynamics of parents' labour market behaviour following receipt of different childcare subsidies. This is another way in which our paper differs from most existing studies, which tend to focus on estimating the impact of childcare subsidies at a particular point in time following receipt of the subsidy or its average impact across several months or years of eligibility.[2]

Our main findings are that mothers whose youngest child becomes eligible for free part-time childcare increase their labour force participation only in the third term of entitlement, by 2.1 percentage points (3.4% of the baseline participation at age 3), but are no more likely to be in work than mothers whose youngest child is eligible for no free care. We find no effects for fathers or for mothers for whom it is not their youngest child who is eligible. This relatively small response is consistent with the changes in childcare use that we find: the entitlement to free part-time childcare increases the amount of time that children spend in childcare by just 1.6 hours a week, on average. This is because the policy of providing free care crowds out paid-for formal childcare as well as informal care.

We find a much greater impact of free full-time care on maternal labour supply: in the first term of full-time eligibility the probability of being in the labour force is 3.1 percentage points higher and the probability of working is 1.2 percentage points higher than in the third term of free part-time childcare. Moreover, these impacts increase over the months following entitlement, such that, by the

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[2] Brewer and Crawford (2010), Lefebvre et al. (2009) and Nollenberger and Rodriguez-Planas (2015) are exceptions. See further discussion of these papers in Section 2.

end of the first year of full-time eligibility, mothers whose youngest child is eligible for free full-time care are 5.7 percentage points (or 8.7% of the baseline) more likely to be in the labour force and 3.5 percentage points (or 5.9% of the baseline) more likely to be in work than mothers whose youngest child is in their third term of part-time entitlement. We find that these impacts are stronger amongst lone mothers and solely concentrated amongst mothers who have no additional younger children. We also show that the effect on the labour supply of fathers is negligible. Consistent with this, we find evidence that the rise in the use of subsidisable childcare following entitlement to full-time free childcare does not crowd out the use of other forms of childcare.

The remainder of this paper is organised as follows: Section 2 summarises the existing literature and outlines how our study contributes to it. Section 3 provides background on childcare policy in England. Section 4 outlines our data and empirical strategy. Section 5 presents our results, heterogeneity analysis and robustness checks, and Section 6 concludes.

2.   Related literature

Early studies on the link between childcare and parental labour supply focused on estimating structural parameters of utility functions to recover the elasticity of maternal employment with respect to childcare prices. These parameters are difficult to estimate in an unbiased way because of the difficulty of finding valid instruments to deal with the simultaneity of childcare and labour supply decisions, and the challenge of imputing childcare prices amongst those who do not use formal childcare (see Brewer and Paull (2004) and Blau and Currie (2006) for further discussion).

To overcome these issues, more recent studies have used policy changes as "natural experiments" to generate exogenous variation in the price and/or availability of formal childcare. Most of these studies focus on mothers and evaluate the impacts of a wide range of childcare policies introduced in a number of countries by using one of two different empirical strategies. The majority exploit variation arising from differential expansion of subsidised childcare or public education over time across geographical areas, and a few estimate the link between childcare and maternal labour supply by using variation arising from date-of-birth discontinuities in the rules determining eligibility for, or admission to, childcare programmes.[3]

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[3] Examples of studies exploiting temporal or geographical variation are Berlinski and Galiani (2007), Baker et al. (2008), Lefebvre and Merrigan (2008), Cascio (2009), Lefevbre et al. (2009), Nollenberger and Rodriguez-Planas (2015), Schlosser (2011), Havnes and Mogstad (2011), Herbst (2013), Sall (2014) and Bauernschuster and Schlotter (2015), and examples of studies using date-of-birth discontinuities include Gelbach (2002), Brewer and Crawford (2010), Fitzpatrick (2010, 2012), Goux and Maurin (2010), Berlinski et al. (2011), and Bauernschuster and Schlotter (2015).

Our paper follows the latter tradition, as it exploits discontinuities in eligibility based on date-of-birth cut-offs. But it departs from existing literature in that we are able to estimate the impacts of both part-time (around 15 hours per week) and full-time (30-35 hours per week) childcare in the same country, over the same time period, and using the same data and empirical strategy. This enables us to estimate the impact of *extending* entitlement from part-time to full-time care.

A priori, it is not clear how the impact of extending entitlement to free childcare from part-time to full-time would compare to the impact of offering part-time care vs. nothing, and a high degree of heterogeneity in impacts is to be expected given the likely heterogeneity in gains from selecting into childcare and into the labour market (Cornelissen et al., 2016). There are arguments to suggest that the impact of an additional 15-20 hours a week of free care could be greater amongst parents who are not in work: it might be easier to work when 30-35 hours of free childcare are provided in the same place, rather than 15, or it might be that it is only when 30 hours of free childcare are offered that the benefits of working exceed the fixed costs. On the other hand, if those closest to the labour market went into work when their child was offered free part-time childcare, then the impact of an additional 15-20 hours of childcare could be smaller than the first 15 hours. Moreover, amongst parents who are already in work, the extension of the subsidy has *a priori* ambiguous effects on the number of hours worked and its impact will depend on the relative strengths of the income and substitution effects for different parents.

The existing empirical literature offers little guidance as to the likely effects of such a policy. As noted by Bauernschuster and Schlotter (2015) and Cattan (2016), the context in which childcare subsidies have been introduced seems to be an important driver of the magnitude of their impact on labour supply, with larger impacts generally found where employment rates and childcare attendance are relatively low and where state-provided or subsidised childcare does not crowd out private childcare to a significant extent. For instance, Havnes and Mogstad (2011) study the large expansion in free, full-time childcare availability for children aged 3-6 in the late 1970s in Norway, where about 70% of women were in work and informal or privately paid childcare was largely used, finding that the reform led to no significant impact on maternal labour supply. Nollenberger and Rodriguez-Planas (2015), on the other hand, investigate the large-scale provision of free, full-time childcare for 3 year olds in Spain in the early 1990s, where maternal labour force participation hovered around 35% and childcare use was low prior to the reform. Using a similar difference-in-differences strategy to Havnes and Mogstad (2011), they find that offering public childcare increased maternal employment by 9.6 percent, a large effect given the context of extremely low labour demand and the relatively traditional view of gender roles in Spanish culture at the time.

Our analysis focuses on England, at a time when rates of female employment and childcare usage fell between those observed for Norway and Spain, and were roughly similar to those observed in Quebec at the time of the 1997 reform evaluated by Baker et al. (2008). This reform gradually introduced a network of childcare services for all children up to 4 years of age, where parents could access care for up to 10 hours a day, 261 days a year, at a cost of no more than $5 per day. Baker et al. (2008) find that this policy increased mothers' employment rates by 7.7 percentage points (14.5% of the baseline), but it is difficult to infer from this the likely effects of expanding childcare provision in England, as the Quebec reform is very different to the policies that we evaluate, and in any case focuses on the introduction (rather than extension) of subsidised childcare.

There are a few studies that estimate the impact of increasing the childcare subsidy on offer, but these tend to focus on the effect of extending childcare for older children, such as through extensions of the school day, and in contexts which are quite different to the situation in England in the early 2000s. For example, Berthelon et al. (2015) exploit geographical variation in adoption of a policy to increase the length of the primary school day in Chile by around 35% in order to investigate the impact of these additional hours on mothers' labour supply. Their results show that the extension had a significant impact on the labour force participation and labour force attachment of mothers whose children were in primary school. Lundin et al. (2008), on the other hand, assess the impact of further increasing already high childcare subsidies on mothers of children aged 1-9 in Sweden and find no impact on mothers' employment and hours of work (amongst those who are working).

Our paper adds to this literature in at least three distinct ways. First, it offers direct evidence of the impact on both mothers and fathers' labour supply of offering free part-time and free full-time childcare. Importantly, we do so within the same institutional context and time-period, using the same data and methodology, which allows us to estimate the impact of *expanding* the provision of free childcare from half-day to full day amongst children under five. This contrasts with the vast majority of existing studies on this topic, which focus on mothers only and study the impact of offering subsidised or free childcare compared to offering nothing. Our analysis focuses on England, but as a country with relatively similar levels of maternal employment to other Anglo-Saxon and Northern European countries, the results are likely to be relevant for countries such as Germany and Wales that are considering expanding their own offers of free childcare from part-time to full-time, as well as countries such as the US that are looking to increase childcare subsidies in other ways.

The second contribution of our paper is that it is the first to adopt an empirical strategy that exploits date-of-birth discontinuities and uses longitudinal data. Gelbach (2002), Fitzpatrick (2010), Goux and Maurin (2010), Berlinski et al. (2011) and Bauernschuster and Schlotter (2015) also exploit date-

of-birth discontinuities, but use cross-sectional data (Census data in most cases) and control for a limited number of covariates. In contrast, we include parent fixed effects and thus control for any time-invariant differences in labour market outcomes between parents with children born in different months of the year, making our estimates potentially more robust than those found by previous studies.

Third, our paper estimates separate impacts for each of the first three terms of eligibility for both free part-time and full-time childcare. By contrast, existing studies have generally estimated the impact of childcare subsidies on maternal labour market outcomes at a single point in time following the child's eligibility (typical amongst RD approaches, e.g. Goux and Maurin, 2012; Fitzpatrick, 2010; Bauernschuster and Schlotter, 2015) or its average impact across several months or years of eligibility (more common amongst studies that exploit staged expansion of childcare provision, e.g. Havnes and Mogstad, 2011; Berlinski and Galliani, 2007). Our paper adds to a small set of papers interested in the dynamics of mothers' labour market behaviour following receipt of a childcare subsidy and finding persistence in or even a growth of the impacts on labour supply over time (Brewer and Crawford, 2010, Lefebvre et al., 2009, Nollenberger and Rodriguez-Planas, 2015).

3.   Institutional background

3.1   Childcare policy in the UK

The UK has a relatively high rate of female employment, but the employment rate of mothers of pre-school children is below the OECD average (62% vs. 67%, see OECD, 2016). Low maternal employment rates, together with the perception that childcare is not affordable for many families, has contributed to a substantial increase in public support for pre-school childcare in England (and the rest of the UK) over the past 20 to 25 years: after lagging well behind most European countries in the early 1990s, the UK is now one of the highest spenders on pre-primary services in Europe (OECD, 2014a).[4]

During the 2000s, the period of interest in this paper, government support for childcare in England took three main forms. First, a refundable tax credit that subsidises up to 80 percent of spending on formal childcare amongst low- to middle-income working families, subject to weekly ceilings and to an income test. Second, a scheme to allow employers to pay childcare vouchers that are free of

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[4] We switch (deliberately) in this section between the UK and England. Childcare and education policy varies between England, Wales, Scotland and Northern Ireland, and this paper uses data from England to look at a policy that existed only in England. International comparisons are by necessity made at the level of the UK. 84 per cent of the UK's population live in England.

personal income tax and social insurance contributions. Third, in England, an entitlement to free childcare for all three and four year olds, and, more recently, the 40% poorest two year olds, currently for 15 hours a week during term-time (38 weeks a year).[5] This entitlement for three and four-year-olds is one of the two policies we exploit in this paper to estimate the impact of free childcare on maternal labour supply. We provide more details on this policy next.

3.2   Free part-time childcare for 3- and 4-year-olds

Since the early 2000s, all three and four year olds in England have been entitled to receive free part-time childcare before entering full-time primary education (which they would typically do at age 4 or 5). This entitlement has been in place for all four-year-olds since 2000, and for all three-year-olds since 2004. When the policy was first introduced, it offered 2.5 hours of free childcare per day (12.5 hours per week) for 33 weeks a year. This was extended to 38 weeks a year in 2006, and to 15 hours a week in 2010. Since 2010, it can also be taken with greater flexibility: in some settings, families can now use the hours across a minimum of three days, making it easier to combine with work. The free entitlement policy does not involve government directly providing, or even contracting to provide, additional childcare places. Instead, parents can either use their entitlement in a centre-based childcare facility run by the private sector, in which case the policy effectively acts as a full or partial rebate of childcare fees, or in a public (state-funded) nursery school, or a nursery class in a public primary or infant school.[6]

Take-up of places amongst three year olds has risen over the period, from 82% in 2004 to 94% in 2015 (Department for Education, 2015). The majority of children who take up a place use all of the hours to which they are entitled each week: in January 2015, for example, 79% of 3 year olds used between 13 and 15 hours, against a maximum entitlement of 15 hours a week (Department for Education, 2015). As Blanden et al. (2016) show, the fraction of three-year-olds attending childcare in a public (state-run) institution did not change between 1999 and 2007 (it stood at 37% in 1999 and 38% in 2007), and so the policy can be thought of as extending to the 62-63% of children not using free childcare in a public facility the right to access free care in a private setting. As a result, we

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[5] This package offers very heterogeneous levels of support for childcare across different types of families in the UK. For example, the OECD's calculations for a specimen low-wage lone parent with two children (aged 2 and 3) and with full-time earnings at 50% of the average wage suggest that he or she would spend a relatively low 8% of net income on childcare, below the EU and OECD average. In contrast, a specimen relatively well-off couple with two children aged 2 and 3) which jointly earned 150% of the average wage are estimated to spend 34% of their net income on childcare – the highest in all OECD countries (OECD, 2014b).

[6] The existence of these public (state-run) institutions providing childcare pre-dates the policy we study: since the early 1990s, some local authorities in England have been providing free pre-school education in nursery classes in schools or in stand-alone nursery schools. Local authorities had no statutory obligation to provide such pre-school places, and there is large variation in their availability between areas, with local councils in inner city areas traditionally controlled by the Labour party (the main left-of-centre political party) typically providing the highest coverage.

consider that the main impact of this policy was not to increase directly the provision of formal childcare, but instead to reduce the cost to parents of using privately-produced formal childcare.

Crucial to our identification of policy impacts are the various discontinuities in eligibility caused by date-of-birth admission rules. Children become eligible for a free part-time childcare place at the start of the academic term after they turn three. This means that children born between 1 January and 31 March ('spring-borns') are eligible for a free place from 1 April of the year they turn three; children born between 1 April and 31 August ('summer-borns') are eligible for a free place from 1 September of the year they turn three; and children born between 1 September and 31 December ('autumn-borns') are eligible from 1 January of the calendar year in which they turn four. Children remain entitled to part-time childcare until they enter full-time primary education, the policy we exploit in this paper to identify the impact of extending care from part-time to full-time hours.

3.3   Free full-time childcare for 4-year-olds

Parents in England are statutorily obliged to send their child to school from the school term that begins after the child's fifth birthday (the "statutory school age"), earlier than in most OECD countries. However, schools have the discretion to admit children earlier than this, and almost all children in England are able to attend full-time school (covering 30 to 35 hours a week, depending on school policy, for 39 weeks a year) before the statutory school age. Indeed, in 2012 more than 99% of children in England started school in an area which allowed them to do so in the September after they turned four, up from around 80% in the early 2000s.[7] Parents do not have to send their child to school earlier than the statutory school age, but, as we show in the next section, the vast majority of children do start school in the September after they turn four.[8]

This policy introduces further variation in entitlement to childcare which is crucial to our identification strategy. The fact that most children start school in the September after they turn four generates variation in both the age at which children become entitled to full-time care and the number of terms of part-time care that those born in different months of the year receive. For example, children born one day apart on 31 August and 1 September 2011 would be eligible for a

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[7] Source: authors' calculations using administrative data on children attending state schools in England from the National Pupil Database. Schools which do not offer all children the opportunity to start school in the September after they turn four instead operate dual or triple entry point systems, with date-of-birth cut-offs determining which children start in which term. Under the second most common admissions policy (covering around 9% of children in the early 2000s, falling to less than 0.1% of children by 2012), children born between 1 September and 29 February are entitled to start school in the September after they turn four, while children born between 1 March and 31 August can start school in the January after they turn four. These sorts of policies have become less common over time, as central government has encouraged local authorities to allow parents to start school at the beginning of the school year after their child has turned four.

[8] One reason for this is that caps on class sizes mean that parents often cannot secure their child's place at a particular school if they defer entry.

free part-time nursery place four months apart (1 September 2014 vs 1 January 2015), and a free full-time school place 12 months apart (1 September 2015 vs 1 September 2016).

4.   Data and empirical strategy

This section describes our data on labour market outcomes, discusses our empirical specification, and presents empirical evidence motivating our research design.

4.1 Data

Our empirical analysis of the effect of free childcare on parental labour supply is based on the Labour Force Survey (ONS and NISRA, 2014), a large-scale household survey covering the whole of the UK, similar to the Current Population Survey in the US. The LFS is a quarterly survey with a rotating panel structure, which means that households are interviewed up to five times over a 12 month period.

Our sample from the LFS includes any mother with at least one child aged 0 to 6 at the time of the interview (up to the end of that child's second year in school), interviewed between 2000 and 2013. Our analysis of fathers' outcomes is based on the male partners of these mothers. We drop families with missing data on the labour market outcomes of interest, those who change local authority over the period of observation or for whom we do not observe key characteristics, such as the date of birth of their children.[9] Although we do not require a balanced panel, the use of mother and father fixed effects means that households that appear once in our sample – either because their five quarters in the LFS are left- or right- censored by our observation window, or because they attrit from the survey after their first interview – are not used. To scrutinise how these sampling decisions affect the external validity of our results, Table 1 provides summary statistics of key characteristics of our initial sample and of our estimation sample. The means of all the variables are very similar to each other in the initial and final estimation samples, indicating that sampling decisions do not bias our results.

As we show in Panels A and B of Table 2, maternal labour market outcomes in our estimation sample vary considerably by background and age of the youngest child. As expected, both employment rates and labour force participation rates increase with the age of the youngest child, with employment rates rising from 54% among mothers of 1-year-olds to 60% among 4-year-olds. Employment rates of lone mothers and of low educated mothers (those with less than A-levels which

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[9] We drop those who change local authority in order to cluster our standard errors at the local authority level.

is the equivalent of a high school degree in the US) are at least 10 percentage points below the average at all ages of the youngest child. These are the sorts of mothers for whom we expect childcare affordability to be a particularly binding constraint and therefore for childcare subsidies to have a larger effect. Moreover, labour force participation rates are higher than employment rates at all ages of the child, indicating that a proportion of mothers of young children are looking for work. By contrast, fathers' labour force participation and employment rate don't change at all with the age of the youngest child, hovering around 95% and 91% respectively.

4.2   Econometric specification

We estimate separate models of the impact of free childcare on the labour market outcomes of mothers and fathers. For ease of exposition we describe our main specification for mothers. Our father-level equations are specified in exactly the same way.

Our main specification is the following mother-level linear equation:

$$Y_{i,t} = \sum_{\tau=1}^{5} \pi_\tau^{PT} EligPT_{i,t,\tau} + \sum_{\tau=1}^{6} \pi_\tau^{FT} EligFT_{i,t,\tau} + \beta'X_{i,t} + \delta_t + \alpha_i + \varepsilon_{i,t}, \qquad (1)$$

where $Y_{i,t}$ is a labour market outcome for mother i at time t, and the key treatment variables, $EligPT_{i,t,\tau}$ and $EligFT_{i,t,\tau}$, are binary indicators for whether mother i has any child who is eligible for free, part-time childcare and free, full-time childcare at time t, respectively. These variables are indexed by τ because they are interacted with dummy variables indicating if the mother is observed in the child's τ-th school term of entitlement in order to allow for the fact that the response to free childcare may evolve over time. τ varies from one to up to five terms for part-time care and from one to up to six terms for full-time care.[10] Our choice to model labour supply as a function of whether *any* child in the household is eligible for part-time or full-time work contrasts with most papers in the related literature (with the exception of Lundin et al., 2008), which instead mostly estimate the impact of a particular child's entitlement to childcare on maternal labour supply. The advantage of adopting a mother-level, rather than a child-level approach, is that it captures the possibility that parents choose their labour supply as a function of all of their children's ages and the eligibility for free different types of childcare amongst one or more children.

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[10] Summer-born children are eligible for three terms of part-time childcare, spring-born children for four terms of part-time childcare and autumn-born children for five terms of part-time childcare before they enter full-time schooling. While we estimate effects for all five terms, we report coefficients only for the first three terms, to which children born in all months contribute. The age restriction on the children included in our sample also means that, while we estimate the effects of full-time care in all six terms, only summer-born children contribute to estimates of the impact of full-time childcare in the fourth, fifth and sixth terms of entitlement. Again, therefore, we only report coefficients for the first three terms, to which children born in all months contribute.

Other covariates include a set of quarter dummies, δ_t, to capture seasonal effects and a vector $X_{i,t}$ of time-varying characteristics of the mother and her children.[11] Specifically, $X_{i,t}$ includes an indicator for whether the mother has a partner at the time of the interview and a flexible function controlling for the number and ages of the mother's children. Controlling comprehensively for children's ages is important so as not to confound the impact of eligibility with the generally positive labour market effect of children growing older. Our preferred specification for this age function is to include a full set of dummies for the age in months of the youngest child and four variables measuring the number of children in the age bands 0-2, 2-4, 5-9 and 10-15. We cannot include age dummies for all children as, together with mother fixed effects, they would be perfectly collinear over time. In section 5.3, we show that our estimates are robust to alternative ways of controlling for children's ages.

The availability of longitudinal data allows us to include mother fixed effects, α_i, in equation (1). These control for any unobserved time-invariant characteristics of mothers, and thus for any time-invariant differences between mothers whose children are born, and became entitled to childcare, at different points throughout the year. This may be important if, as has been found by some other studies (e.g. Buckles and Hungerman, 2013), mothers trying to conceive at different times of the year differ in time-invariant observed and unobserved ways, for example by family background and in their preferences for births in a particular season (e.g. depending on expected weather at birth and schooling laws).

We estimate the equation above for a rich set of labour market outcomes, including binary indicators for the mother's labour force participation, employment status, whether she engages in job search whilst unemployed or inactive, and different measures of labour supply at the intensive margin. Specifically, we estimate the model for the mother's usual hours of work, as well as three binary indicators for working 1-15 hours, 16-29 hours, and 30 or more hours per week. We choose these groupings as they relate to important thresholds used in the assessment of entitlement to in-work support in the UK and are also closely aligned with the part-time and full-time childcare offers whose effects we estimate in this paper.[12] The outcomes relating to hours of work take a value of zero if the mother is not in work. The job search outcome takes a value of zero if the mother is in work.

All outcomes relate to the seven days ending Sunday prior to the interview date. As LFS interviews take place continuously throughout the year, the impacts we estimate are implicitly averaged over

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[11] Because we include mother fixed effects in our model – and only follow each mother for a maximum of 5 quarters – we do not to include year dummies in our main analysis. Their inclusion does not materially change our results, however. Results available from the authors on request.

[12] Specifically, lone parents have to work at least 16 hours per week – and women in couples at least 30 hours per week – in order to be entitled to support via working tax credit.

school term-time and school holidays. Similarly, a child is defined as eligible for part-time or full-time childcare in all weeks once they reach the critical age, regardless of whether their mother is observed inside or outside school term time.

In all specifications, we cluster standard errors at the local authority level.[13]

4.3 Relevance of eligibility rules for the take-up of childcare

In equation (1), the vector π containing the coefficients of interest captures the impact of being offered free childcare on mothers' labour supply. This is the Intention-To-Treat parameter, which is the relevant parameter for computing the total benefits of the policy. It is also the parameter that is estimated in most papers in the literature. A central assumption in interpreting these results as reflecting the impact of underlying changes in childcare use on maternal labour supply, however, is that the eligibility rules that govern access to free part-time childcare at age 3 and free full-time schooling at age 4 bind the take-up of free childcare in reality.

To demonstrate the validity of this assumption, we take two approaches. First, we use administrative data on all pupils attending state schools in England to show graphically that children born at different times of the year take up free part-time and full-time childcare at the ages we expect them to, and that these ages vary by season of birth.[14] Figure 1 shows in bold lines the ages in months (panel A) and points in time (panel B) at which children born in different terms (autumn, spring or summer) move into full-time care. Most children start full-time school in the September after they turn four, generating variation in the age and date at which they transition from part-time to full-time care. Summer-born children access full-time care shortly after they turn four, while spring-born children are aged about 4.5 when they start school, and autumn-borns are almost five when they make this transition (panel A). Following children from the September after they turn three (as we do in panel B) highlights that this is achieved by summer-born children starting school in the academic year preceding those born in the spring and autumn terms.

Data restrictions in school administrative data mean that, in order to identify correctly the date at which children start and leave part-time care, we can only use children who take up part-time care in a public (state-funded) institution and then take up full-time education at a different institution that

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[13] We cluster at the local authority (LA) level because LAs are largely responsible for the local provision of education and children's social services, which could generate some correlation across the error terms of parents living in the same LA. As outlined earlier, school admissions policies also vary by area. Accounting for the most common school admissions policy in operation in the local area does not affect our findings. Results available from the authors on request.

[14] All state-funded schools in England are required to provide information about the pupils on their roll to the national Department for Education on three census dates each year. As part of this return, information is collected on the month and year of birth of each child in the school and the date on which they entered the school.

itself does not offer part-time care. Around 12% of pupils fall into this category[15], and their participation in part-time childcare is shown in dashed lines in Figure 1. As expected, we see that children start using free part-time childcare around the time they turn three (panel A), with summer-borns accessing care around four months earlier than spring-borns and around eight months earlier than autumn-borns (panel B). This variation over time/age and between children born in different months is precisely the variation that forms the basis of our identification strategy.

The second approach we use to demonstrate that eligibility rules impact on take-up of childcare is more closely aligned with our main analysis, as it uses survey data to estimate directly the impact of a child's eligibility for free part-time and full-time childcare on take-up of different forms of childcare, separately for the first three terms of entitlement. Specifically, using the Family Resources Survey (FRS), we estimate a version of equation (1) at the child level, where the outcome is a measure of childcare use.[16] The cross-sectional nature of the FRS necessitates that we estimate a version of equation (1) in which we do not include child (or mother) fixed effects but instead include a rich vector of time-invariant characteristics that would be dropped from a fixed effects specification:

$$C_{i,t} = \sum_{\tau=1}^{5} \gamma_{\tau}^{PT} EligPT_{i,t,\tau} + \sum_{\tau=1}^{6} \gamma_{\tau}^{FT} EligFT_{i,t,\tau} + \beta'X_{i,t} + \delta_t + \varepsilon_{i,t}, \qquad (2)$$

where $C_{i,t}$ is a variable measuring use of childcare by child i at time t, the vector $X_{i,t}$ includes a set of characteristics about the mother, father and children in the household[17] and all other covariates are the same as those used for our main analysis, described above. In this specification, the impacts of eligibility rules on childcare use will be causal insofar as there are no unobserved systematic differences between parents of children born in different terms of the year. As we will show in Section 5.3, mother fixed effects turn out to be quite important when estimating the impact of childcare eligibility on maternal labour market behaviour, indicating a large role of unobserved mother characteristics. We cannot rule out that unobserved maternal characteristics are similarly

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[15] This represents a quarter of children who take up free part-time care in a state setting. Children who take up their free place in a state setting are on average poorer, more likely to be non-white and to speak English as a second language than children who access private care. There is no data from private settings that records when children begin to make use of their entitlement to free part-time care.

[16] The Family Resources Survey (DWP et al., 2016) is a yearly repeated cross-sectional household survey that collects information on the incomes and circumstances of private households in the UK. Our sample includes children between the age of 2 and 7 at the time of the interview, living in families in England who are interviewed between April 2005 and March 2013. The FRS collects detailed information on all the ways in which children are looked after in a reference week. We make an adjustment to this data so that it correctly captures the time children spend in full-time education.

[17] These include the age of the child in month dummies, the age and educational qualifications of the main carer and (if present) her partner, an indicator for whether the mother is married or cohabiting, a dummy for whether the child has any siblings, local authority dummies, and a dummy indicating whether the local authority of residence operated a school admission policy whereby children start full-time education in the September after they turn 4. We also control for the age of other children in the household and year dummies.

important for childcare use and therefore refrain from giving a strong causal interpretation to these results.[18]

We estimate equation (2) for different measures of childcare use, including weekly hours of use and weekly spend by parents (both including zeroes) on any type of childcare and on three specific types of childcare: subsidisable care (i.e. care provided by the sorts of establishments where parents can take up their entitlement to free part-time childcare, which will typically be day nurseries and also state-run infant or primary schools), other formal but non-subsidisable care (such as care provided by childminders and by clubs that run in school holidays or before or after the school day), and informal care (time spent being cared for by family members other than the resident parents, or by friends, or by unregistered childminders or nannies). Appendix Table A1 summarises how some of these outcome variables vary by the age of the youngest child.

Table 3 reports our estimates of equation (2). Panel A displays the impact of eligibility for part-time and full-time childcare at various points in time relative to the impact of no eligibility. Panel B compares the impact of full-time eligibility with the 3rd term of part-time eligibility, and Panel C shows how the impact of full-time eligibility compares to the previous term. Columns (1) and (2) provide strong evidence that when a child becomes eligible for free part-time childcare, her use of subsidisable care significantly increases, and rises further when she becomes eligible for free full-time childcare. Specifically, the use of subsidisable care increases by 17 percentage points by the third term of part-time eligibility, and increases by another 12 percentage points by the third term of full-time eligibility (see column 1). Similarly, at the intensive margin, we see an increase in use of subsidisable care of about 3 hours a week in response to having eligibility for part-time care, and a further increase of 2.5 hours a week by the third term of eligibility for full-time childcare (see column 2). At the same time, parents spend £7 pounds a week (in 2012 prices) less on subsidisable care when their child becomes eligible for free part-time care, and almost £14 a week less when he or she becomes eligible for free full-time care (column 3). Results focusing only on the youngest child's eligibility are shown in Appendix Table A2 and are similar to those for all children.

These results demonstrate that eligibility for free care does cause changes in childcare use, but the increase in the number of hours of subsidisable care used is much lower than the notional entitlement

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[18] We explored the possibility of using pseudo-cohort methods to allow for mother-level or child-level fixed effects in equation (2), which would have allowed us to present a two-sample two stage least squares estimate of the causal impact of childcare use on maternal labour supply. Unfortunately, the sample size of the FRS is too small to implement such a method.

of 12.5 or 15 hours a week.[19] This suggests that paid-for care would be used by some parents in the absence of the free entitlement, and this should be expected in a country like the UK that has a large market for privately-provided, paid-for, pre-school childcare. Indeed, Appendix Table A1 shows that 48 per cent of two year-olds who are the youngest in their families are already using paid-for subsidisable care, with an average weekly use amongst this group of 13 hours a week, without being eligible for free care.

We further investigate whether the increase in the use of subsidisable care means that children spend more time in childcare overall or whether they substitute away from other forms of childcare (informal or privately paid but not subsidisable care). Columns (4) through (6) of Table 3 show that there is an increase in the number of hours of any childcare used when a child becomes eligible for free part-time childcare, but this increase is a third of the size of the increase in subsidisable care reported in column (2), suggesting that there is substantial crowding-out of other forms of care by free formal childcare arrangements. As columns (5) and (6) indicate, parents primarily substitute away from informal care arrangements when formal care becomes free of charge. There is evidence of a smaller degree of crowd-out when children become entitled to full-time care: the rise in the total number of hours of childcare used (compared to the third term of entitlement to free part-time childcare) is actually slightly larger than the rise in the number of hours of subsidisable care, This overall rise, though, at 2.8 hours a week, is still considerably smaller than the additional notional entitlement, and the fact that spending on childcare falls by about £9 a week suggests that the additional entitlement to care is crowding out paid-for formal childcare.

Taken at face value, these findings lead us to expect that offering free part-time and full-time childcare may have some impact on mothers' labour market participation, with the impact being greater for full-time than part-time care, but we expect the impacts to be moderate in magnitude. We now turn to presenting our estimates of these impacts.

5. Results

5.1 Main results

Tables 4 and 5 present our main estimates of the impacts of entitlement to free part-time and full-time childcare on maternal labour market outcomes. Table 4 presents the results for all mothers of an

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[19] 15 hours a week free care for 38 weeks a year is just under 11 hours a week averaged across a year: this is the relevant number to consider when interpreting the results in Table 3, which report the impact on childcare used in the previous week averaged across the year.

eligible child, and Table 5 reports the impacts for mothers whose youngest child becomes eligible. Results for non-youngest children, estimated in the same model as those for youngest children are reported in Appendix Table A3. All of our outcomes are observed for fathers as well as mothers, and the impacts of free part-time and full-time childcare on fathers whose youngest child is eligible are presented in Table 6; this shows that fathers' labour supply is unaffected by the provision of free childcare, and thus the rest of our discussion focuses on mothers.[20]

Impact of entitlement to free part-time childcare

The top three rows of Tables 4 and 5 report the effect of eligibility for free part-time childcare (relative to no free childcare) in each of the first three terms of entitlement. Amongst all mothers with a 3 year old child, there is little evidence that entitlement to free part-time childcare allows more mothers to move into the labour force or paid employment. Amongst mothers whose youngest child becomes eligible for free childcare, impacts are slightly larger in magnitude, though they become statistically significant only in the third term of part-time eligibility, when we estimate that eligibility for part-time childcare increases labour force participation by 2.1 percentage points (3.4% of the baseline), but has no statistically significant effect on the likelihood of being in work. Overall, these patterns suggest that providing free part-time childcare is not a strong enough incentive for mothers to move into the labour force and/or that it may take time for mothers who have been out of the labour force to decide to make themselves available for work, let alone to find a job.

Tables 4 and 5 also show that there is no immediate impact of free part-time childcare on weekly working hours (see the first three rows of column 3). However, when breaking down working time into the categories 1-15 ('short' part-time), 16-29 ('long' part-time) and 30 or more hours (full-time), we find that having a child eligible for part-time childcare both reduces mothers' probability of working 16-29 hours and increases their probability of working 30 or more hours per week, with impacts that are similar in magnitude though not statistically significant in all cases (see columns (5) and (6)). These results suggest that having a child who is entitled to free part-time childcare may increase the hours of work of mothers with greater attachment to the labour market (who would be working even in the absence of the subsidy), even though it does not increase the overall probability of being in work.

Impact of entitlement to free full-time childcare

The second three rows of the top panels of Tables 4 and 5 present the estimated impacts of becoming eligible for full-time childcare of about 6.5 hours a day (relative to no childcare) in each of the three

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[20] Impacts on fathers of eligibility of their non-youngest children are reported in Appendix Table A4 and show no effect.

terms after a child first becomes eligible for this care. Across the whole sample, we detect no significant impact on any of the labour market outcomes, except for a continuation of the switch from 'long' part-time to full-time work in the first term of eligibility for full-time care. However, Table 5 shows that the effects for mothers whose youngest child is eligible for free full-time care are considerably larger across a range of labour market outcomes. In particular, when their youngest child becomes eligible for free full-time care, the probability of mothers entering the labour force increases by 5.2 percentage points in the first term of entitlement. Of those moving into the labour force, around a third (1.9 percentage points) move into work – mostly 'short' part-time work (1-15 hours per week). We also find an increase of 2.4 percentage points in the fraction of mothers looking for work.

As discussed earlier, one innovation of this paper is our ability to assess the empirical impact of *extending* entitlement to free childcare from part-time to full-time on parental labour supply, an impact whose direction is *a priori* ambiguous. To show this, we report, in the middle panel of Tables 4 and 5, the impacts of the first, second and third terms of entitlement to free full-time childcare relative to those of the third term of entitlement to free part-time childcare.[21] The results show that extending the subsidy from 3 hours a day to 6.5 hours a day increases mothers' labour supply in a variety of ways, but these impacts are concentrated amongst mothers whose youngest child is entitled to this extension. For these mothers, the probability of being in the labour force, being in paid work, working full-time, and looking for work are all significantly higher in almost all terms of eligibility for full-time childcare than in the third term of eligibility for part-time childcare.

For example, in the first term of eligibility for full-time care, the probability of being in the labour force is 3.1 percentage points higher and the probability of working 1.2 percentage points higher than in the last term of free part-time care, and these impacts grow throughout the first three terms of entitlement. By the end of the first year of full-time eligibility, mothers whose youngest child is eligible are 5.7 percentage points (8.7% of the baseline) more likely to be in the labour force and 3.5 percentage points (5.9% of the baseline) more likely to be in work than in the third term of part-time eligibility. We also detect small but significant impacts on weekly hours worked, which increase by 0.8 hours by the last term of full-time eligibility. This seems to be driven by increases in full-time work.

Another advantage of our strategy is that it allows us to estimate impacts of the entitlement to part-time and full-time childcare at different points in time after the child becomes entitled. In the last panel of Tables 4 and 5, we report the change in the impact of full-time eligibility in the second and

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[21] This is the last term in which all children are entitled to part-time but not full-time care.

third term *relative* to the previous term. These results demonstrate that there is a significant increase in the probability of being in the labour force, in work and in the number of hours worked per week, and a significant decrease in the likelihood of looking for work, between the first and third terms of full-time entitlement for mothers whose youngest child is eligible (see Table 5). These results suggest that it may take some time for mothers to find a suitable job, emphasising the importance of looking beyond the very short-term effects of the free entitlement when evaluating the effect of the policy on labour supply.

5.2 Heterogeneity analysis

Table 7 shows how our estimates of the effect on labour force participation and paid work of becoming entitled to free part-time or full-time childcare (vs. no free childcare) vary across different groups of women and different policy periods. We focus on mothers whose youngest child is entitled to free childcare, as almost all of the significant impacts of the policy were for this sample only. Column (1) shows how the impacts differ by whether the mother has a co-resident partner, column (2) by the mothers' educational attainment (with low educated mothers defined as those having less than A-levels, equivalent to less than a high school degree in the US), column (3) by the unemployment rate in the local area, and column (4) by policy-period.

Column (1) shows that the impacts on labour force participation of part-time and full-time eligibility are significantly larger for mothers without a partner than for mothers with a partner. This is consistent with the idea that women with a partner have more non-labour income available to pay for childcare before the subsidy kicks in, or more ability to schedule their work hours so that their partner can provide childcare, meaning their labour supply response to the offer of free childcare is smaller than that of lone mothers.

Column (2) demonstrates that there are no significant differences in the impact of free childcare between mothers with high and low education qualifications, except that less educated mothers seem to enter the labour force more quickly than more educated mothers, possibly reflecting the fact that they face tighter financial constraints on paying for childcare. We also find significant differences in the impact of the subsidies on the intensive margin of mothers with high and low education, with the shift from 'long' part-time to full-time work that we noted for all mothers in the previous section concentrated amongst more educated mothers (see Appendix Table A5).

Column (3) shows there is no evidence that local labour market conditions (defined as having a local unemployment rate above the national median) affect the impact of the childcare subsidy on maternal

labour supply. Finally, column (4) of Table 7 allows the impact of eligibility for part-time childcare to be different across four periods: before 2004, in 2004 and 2005, in 2006 to 2009, and from 2010. As discussed in Section 3, although all three-year-olds in England have been entitled to receive free part-time childcare since 2004, the amount and flexibility of this subsidy has changed over time. Before 2003, the entitlement was only effective in a few Local Authorities. When the policy was first made universal in 2004, it offered 2.5 hours of free childcare per day for 33 weeks a year. The subsidy was extended to 38 weeks a year in 2006, and to 15 hours a week in 2010. Moreover, since 2010, these 15 hours can be used across a minimum of three days, possibly making it easier for families to combine with work. The results in column (4) suggest that these changes to the policy have increased its ability to promote maternal labour supply. For example, in the third term of part-time eligibility, the probability that mothers participate in the labour force and are in paid work is 2 percentage points higher after 2010 than in 2004/2005. These results suggest that providing more, and more flexible, hours of free childcare has more of an impact on mothers' work choices.

5.3. Robustness checks

We conduct a variety of robustness checks on our estimates of the impact of entitlement to free part-time and full-time childcare on mothers' labour supply, and report the results of some of these in Table 8, focusing on the effects for youngest children only, and on whether mothers with eligible children were more likely to enter the labour force and to be in work.

Functional form of children's age effect. Controlling appropriately for the age of the youngest child and the age of any other children in the household is crucial to accurately isolate the effect of the policy on maternal labour supply. Our main specification controls for the age of the youngest child through age-in-month dummies and for the number and age of other children in the household through a set of variables measuring the number of children in the following age bands: 0-2; 2-4; 5-9; 10-15. We investigated the sensitivity of our results to controlling for the ages of all children in the household in a variety of alternative ways, and report the most detailed of these in Column (1) of Table 8. Specifically, this specification adds cubic controls for the ages of up to the next six youngest children in the household (in addition to age-in-month dummies for the youngest child and the age band dummies used in the main specification). Comparing the first column of Table 8 with the baseline results reported in columns (1) and (2) of Table 5 shows that the results are almost identical, reassuring us that we have adequately accounted for age effects in our baseline results.

The importance of mother fixed effects. A strength of our research design is that we exploit both longitudinal data and date-of-birth discontinuities to identify the impact of free childcare eligibility on maternal labour supply. In an attempt to understand whether the inclusion of fixed effects matters,

we re-estimate our main specification this time omitting mothers' fixed effects. When we do this, we can then add time-invariant covariates or those that would be collinear in a fixed effects specification, including a cubic in the mother's age, mother's ethnic group, the mother's highest educational qualifications, and a dummy for a new youngest child appearing in the family during the period of observation. The results of this specification are reported in the second column of Table 8 and show that the inclusion of mothers' fixed effects does matter substantially. Indeed, the results without mother fixed effects under-estimate the effect of the policy, highlighting the need for longitudinal or rich cross-sectional data in order to get close to a causal estimate of the effect of childcare subsidies on parental labour supply.

Confounding effects of other policies. During our sample window, two other policies with potential impacts on maternal labour supply were rolled out, and we check that our main results are robust to controlling for their impact. First, we control for a policy reform that abolished unconditional welfare benefits for lone parents. Instead, lone parents had to claim the same welfare benefits - and be subject to the same job-search conditions, backed up by sanctions - as regular unemployed welfare recipients. The reform was phased in by the date of birth of the youngest child and begins to affect lone parents in our sample from 2010 (whose children were in the first year of full-time school from May 2011). To control for the potential impact of the policy we follow Avram et al. (2016), who have evaluated the policy, by including a policy dummy that is set to 1 beginning 12 months before the estimated loss of entitlement to the unconditional welfare benefit. We calculate this based on date of birth of the youngest child in the family. As shown in column (3) of Table 8, the inclusion of this dummy leaves our results unchanged for all mothers whose youngest child is eligible. Our subgroup analysis estimating different impacts for lone mothers and mothers with a partner is also unchanged (see Appendix Table A6).

Second, we return to the results of our heterogeneity analysis where we found positive effects of part-time eligibility for the policy period from 2010 (see column (4) of Table 7), the period in which free hours were increased from 12.5 to 15 per week and could be taken with greater flexibility. It is possible that there were constraints on the supply of free part-time childcare places for 3-year-olds in the early 2000s and that these constraints progressively relaxed until full coverage was achieved, around the same time as the policy became more flexible (as shown in Blanden et al., 2016). In order to disentangle these two potential explanations for the positive effect, we re-estimate our favourite specification controlling for the availability of places, measured as the proportion of three-year-olds with a free childcare place at local authority level. The results (reported in column (4) of Table 8) show that our main results are unaffected by the inclusion of this variable. In Appendix Table A6, we report estimates of the model where we allow for policy period-specific effects while controlling for

our measure of free childcare supply. The results are very similar to those reported in column (4) of Table 7, suggesting that the increasing impacts of entitlement to free part-time care that we observe over time are most likely explained by the fact that the provision of free part-time childcare became slightly more generous and could be taken more flexibly.

6. Discussion and conclusion

As many countries are considering increasing the number of hours of free or highly subsidised childcare available to families with pre-school children, it is important to understand the impacts that such extensions are likely to have on parental labour supply. In the past decade, many studies have estimated the impact of free or subsidised part-time or full-time childcare on maternal labour supply in various contexts and using different methods. To our knowledge, however, none have estimated the impact of extending the offer of free childcare from half-day to the whole of the school day for pre-school children.

Our paper contributes one such analysis for England by estimating the impacts on parents' labour supply of both part-time and full-time free childcare and hence of extending entitlement from part-time to full-time care. In doing so, it also provides the first evaluation of these two major policies on the labour supply of all parents in England. Unlike previous studies, our empirical strategy exploits discontinuities in entitlement to free childcare based on the child's date-of-birth and uses panel data to account for parents' fixed effects.

Our estimates reveal that there is little impact of entitlement to part-time care on the labour supply of either mothers or fathers, but significant impacts of moving from part-time to full-time care for mothers whose youngest child becomes eligible. In the first term of full-time eligibility, the probability of being in the labour force is 3.1 percentage points higher and the probability of being in work is 1.2 percentage points higher than in the third term of free part-time childcare. Moreover, these impacts increase in the months following initial entitlement, so that by the end of the first year of full-time eligibility, mothers whose youngest child is eligible for free full-time care are 5.7 percentage points more likely to be in the labour force and 3.5 percentage points more likely to be in work than mothers whose youngest child is eligible for free part-time care.

When free part-time childcare was introduced in England in the early 2000s, the maternal employment rate was hovering around 55%. England was experiencing a large expansion of its private childcare market, and the rate of informal care was high, especially amongst working families, where over 40% of 3 and 4 year olds used informal childcare (Bryson et al., 2012). In this

context, it is perhaps unsurprising that providing 2.5 hours a day of free childcare was too weak an incentive to encourage many new mothers to join the labour force. While it did allow a few mothers already in work to switch from part-time to full-time work, for most it acted as an income transfer that families used to substitute away from informal care and/or reduce their out-of-pocket expenses on formal care without substantially affecting their labour supply.

This could also explain why our estimates of the impact of free part-time childcare are lower than the positive and significant impacts of similar policies found by Bauernschuster and Schlotter (2015) in Germany and Berlinski and Galiani (2007) in Argentina. When free part-time childcare was introduced in these countries, the employment rate of mothers with 3 and 4 year olds was lower than in England (around 40% in Argentina and 50% in Germany) and, unlike England, there was little alternative childcare provision.

In comparison with countries where free or highly subsidised childcare is offered full-time to parents of pre-school children, our estimates of the impact of free full-time childcare in England are roughly similar to those found in Spain (Nollenberger and Rodriguez-Planas, 2015), thus standing in between the zero impacts found in Norway in the late 1970s (Havnes and Mogstad, 2011) and in the US in the early 2000s (Fitzpatrick, 2010) and the large impacts found in Quebec (Baker et al., 2008). So while our estimates suggest that free full-time childcare is more effective at increasing maternal labour supply than free part-time childcare, it cannot be said to have dramatically transformed mothers' labour market outcomes over this period.

There are at least three reasons why the policy may not have been more effective. First, our analysis suggests that the actual increase in the number of hours of childcare used by parents in response to the offer of free part-time or full-time care is relatively small, as many parents reduce the number of hours of paid for or informal childcare that they are already using. This suggests that the income effect may dominate the substitution effect for many parents.

Second, the offer of free childcare may not start early enough following their child's birth to prevent mothers from leaving their jobs and detaching from the labour force. In contrast with Quebec, where subsidised childcare is offered to children aged 0 to 5, in England the universal entitlement to a free childcare place starts at age 3. While low- and middle- income working families benefit from other forms of childcare support during this critical early period, these subsidies may not be high enough to incentivise mothers, especially low-income mothers, to return to work quickly after their child's birth (Blundell et al., 2016).

Third, the offer may not be sufficiently generous or sufficiently flexible to enable parents to work. In Quebec, for example, parents could access up to 10 hours of subsidised childcare per day, while the offer of free full-time childcare that we have analysed is for 6-6.5 hours a day that can only be taken at set times. Our finding that free part-time childcare had stronger effects on the labour supply of mothers whose youngest child is entitled when it was made more generous and could be taken up more flexibly does suggest that there may be scope to increase parents' labour supply further by offering greater flexibility and/or more hours of care. Certainly, the fact that there is no free entitlement to childcare for parents outside school term time places a significant constraint on the policy's ability to remove financial barriers to work, which may be particularly disadvantageous for lone parents or those from less educated backgrounds.

In considering whether to extend childcare subsidies, however, policymakers need to take into account the other impacts such policies may have, notably on the outcomes of children. Some studies find that children's behavioural outcomes are negatively associated with longer childcare attendance (e.g. Baker et al., 2008, and the studies cited therein), so the potentially positive effects arising from higher parental labour supply must be weighed against the potentially negative effects of spending a longer time each day in childcare.

There are also trade-offs in terms of how the government should spend its limited resources. Offering more hours per week or more weeks per year for all children would either increase the total cost of the policy or necessitate a reduction in funding per child, potentially compromising the quality of provision that could be accessed, with consequences for child development. Governments may therefore wish to consider offering more (flexible) support to a smaller number of parents – rather than less (flexible) support to all parents – in order to maximise the cost effectiveness of childcare subsidies.

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Figure 1: Part-time and full-time care by season of birth

Panel A

Panel B

summer-borns in f/t public schooling	— — summer-borns in p/t public sector care
autumn-borns in f/t public schooling	— — autumn-borns in p/t public sector care
spring-borns in f/t public schooling	— — spring-borns in p/t public sector care
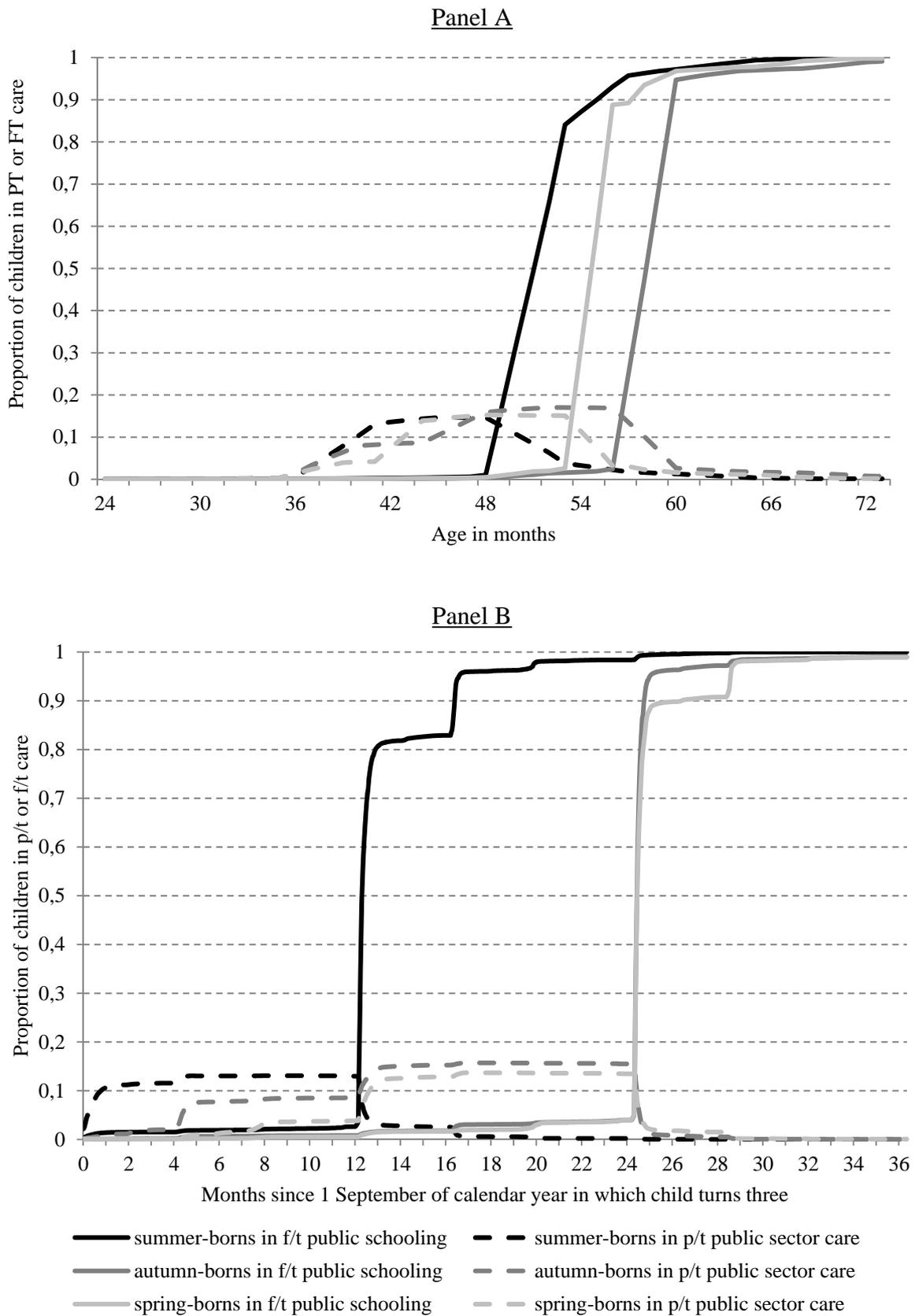
Notes: Authors' calculations using the National Pupil Database. The figure takes as a starting point all children in Year 1 (the second year of primary schooling) between 2005 and 2012 and works backwards to identify when these children entered full-time schooling and, where relevant, when they took up a part-time place in public sector childcare. We only observe both part-time and full-time entry dates for the 12% of individuals who took up their part-time childcare in a different public sector setting than their full-time school place.

Table 1 - Descriptive statistics of the initial and final samples

	(1) Initial sample			(2) Final sample after sampling decisions		
	Mean	Std error	N	Mean	Std error	N
Sample of mothers						
In labour force	0.610	(0.001)	296,866	0.614	(0.001)	275,917
In work	0.568	(0.001)	296,866	0.572	(0.001)	275,917
Works 1-15 hrs/wk	0.107	(0.001)	294,536	0.109	(0.001)	273,821
Works 16-29 hrs/wk	0.237	(0.001)	294,536	0.240	(0.001)	273,821
Works 30+ hrs/wk	0.220	(0.001)	294,536	0.218	(0.001)	273,821
Usual weekly hours	14.305	(0.028)	294,536	14.319	(0.029)	273,821
Looking for work	0.049	(0.000)	296,866	0.049	(0.000)	275,917
Mother's age	33.064	(0.011)	294,830	33.107	(0.012)	275,917
Mother's has a partner	0.773	(0.001)	296,866	0.777	(0.001)	275,917
Mother non white	0.150	(0.001)	296,341	0.144	(0.001)	275,883
Mother low education	0.507	(0.001)	296,262	0.502	(0.001)	275,602
Number of kids under 19	1.976	(0.002)	296,866	1.978	(0.002)	275,917
Age of the youngest child	2.193	(0.003)	295,617	2.203	(0.003)	275,917
Sample of fathers						
In labour force	0.951	(0.000)	229,498	0.953	(0.000)	213,553
In work	0.909	(0.001)	229,498	0.912	(0.001)	213,553
Works 1-15 hrs/wk	0.007	(0.000)	224,803	0.007	(0.000)	209,351
Works 16-29 hrs/wk	0.038	(0.000)	224,803	0.037	(0.000)	209,351
Works 30+ hrs/wk	0.862	(0.001)	224,803	0.866	(0.001)	209,351
Usual weekly hours	38.403	(0.033)	224,803	38.523	(0.034)	209,351
Looking for work	0.041	(0.000)	229,498	0.040	(0.000)	213,553
Father's age	36.447	(0.014)	228,052	36.488	(0.014)	213,553
Father is non white	0.146	(0.001)	229,099	0.140	(0.001)	213,529
Father has < A-levels	0.407	(0.001)	228,098	0.402	(0.001)	212,573
No. of kids <19 in HH	1.971	(0.002)	229,498	1.973	(0.002)	213,553
Age of youngest child	2.112	(0.003)	228,611	2.122	(0.004)	213,553

Notes: Sample consists of mothers with a child aged 0-6 between January 2000 and December 2013 and their co-residential partners ('fathers'). Mother/father non white and mother/father low education are listed for information only and are not included in the regression analysis as they are captured by the mother fixed effects.

Table 2 - Average paternal labour market outcomes by age of youngest child

Age of youngest child:	0	1	2	3	4	5
	A - Labour force participation					
All mothers	0.573	0.580	0.596	0.621	0.652	0.715
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Lone mothers	0.341	0.399	0.437	0.500	0.548	0.617
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Low-educated mothers	0.408	0.436	0.467	0.507	0.555	0.629
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
All fathers	0.958	0.955	0.954	0.951	0.948	0.947
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
	B - Employment					
All mothers	0.547	0.539	0.557	0.577	0.598	0.654
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Lone mothers	0.297	0.322	0.365	0.422	0.456	0.509
	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)
Low-educated mothers	0.376	0.383	0.416	0.453	0.491	0.554
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
All fathers	0.910	0.911	0.913	0.915	0.912	0.913
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)

Note: Standard errors of the means are reported in parentheses. Summary statistics are based on our estimation sample in the LFS for years 2000-2013. The sample size for all mothers is 275,917. The sample size for all lone mothers is 61,561 and the sample for all low-educated mothers 138,383. Sample size for fathers is 213,553.

Table 3 - Effect of a child's eligibility to free part-time and full-time childcare on use of childcare

	(1)	(2)	(3)	(4)	(5)	(6)
	Subsidisable care			Any	Other formal	Informal
	Any use	Wkly hrs	Wkly spend	childcare	Wkly hrs	Wkly hrs
A - Impact relative to no eligibility						
1st term PT	0.116***	3.361***	-7.718**	0.314	0.0617	-2.961***
	(0.026)	(0.732)	(3.115)	(0.462)	(0.327)	(0.935)
2nd term PT	0.106***	2.766***	-5.97	1.198***	0.393	-3.03***
	(0.034)	(1.014)	(3.918)	(0.128)	(0.577)	(1.187)
3rd term PT	0.169***	3.296***	-4.257	1.580***	0.678	-3.621***
	(0.039)	(1.249)	(4.495)	(0.354)	(0.688)	(1.394)
1st term FT	0.243***	4.15**	-13.79***	2.710**	-0.397	-2.698
	(0.046)	(1.659)	(5.114)	(1.055)	(0.791)	(1.676)
2nd term FT	0.256***	5.093***	-13.15**	2.380	-0.449	-2.277
	(0.049)	(1.707)	(5.306)	(2.367)	(0.833)	(1.772)
3rd term FT	0.285***	5.713***	-13.65**	2.390	-0.435	-2.152
	(0.050)	(1.781)	(5.454)	(3.126)	(0.869)	(1.874)
B - Impact of FT eligibility relative 3rd term of PT eligibility						
1st term FT	0.0741***	0.853	-9.533***	0.701	-1.075**	0.922
	(0.028)	(1.264)	(3.244)	(1.568)	(0.509)	(0.810)
2nd term FT	0.0875***	1.797	-8.891**	2.013	-1.127**	1.344
	(0.031)	(1.394)	(3.700)	(1.737)	(0.571)	(0.947)
3rd term FT	0.116***	2.417*	-9.39***	2.772	-1.114*	1.468
	(0.032)	(1.402)	(3.396)	(1.906)	(0.587)	(1.003)
C - Impact of FT eligibility relative to the previous FT term						
2nd term FT	0.0134	0.943	0.641	1.312	-0.0524	0.421
	(0.015)	(0.601)	(1.786)	(0.828)	(0.252)	(0.552)
3rd term FT	0.0288**	0.62	-0.499	0.759	0.0139	0.125
	(0.014)	(0.485)	(1.515)	(0.714)	(0.217)	(0.537)

Note: The sample is children aged 2 to 7 at the time of the interview, living in families in England interviewed between April 2005 and March 2013 (N= 17,151). We include eligibility dummies for all children whether or not they are the youngest. Estimates are from linear regressions and control for the age of the child in month dummies, age and educational qualifications of the main carer and partner (if present), an indicator for whether the mother is married or cohabiting, a dummy for whether the child is the only child, Local Authority dummies, and a dummy indicating whether the Local Education Authority of residence operated a school admission policy whereby children start school the September after they turn 4. We also control for the age of other children in the household in the age bands 0-2; 2-4; 5-9; 10-15 in the household. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table 4 - Effect on mothers' labour market outcomes of their child's eligibility to free part-time and full-time childcare

	(1) In labour force	(2) In work	(3) Weekly hours	(4) >0 & <16 hours	(5) >=16 & <30 hours	(6) 30+ hours	(7) Looking for work
A - Impact relative to no eligibility							
1st term PT	-0.003	-0.004	-0.004	-0.002	-0.006	0.004	-0.002
	(0.003)	(0.003)	(0.074)	(0.003)	(0.004)	(0.002)	(0.002)
2nd term PT	0.000	-0.001	0.110	0.001	-0.010**	0.008***	0.000
	(0.005)	(0.004)	(0.105)	(0.003)	(0.004)	(0.003)	(0.003)
3rd term PT	-0.004	-0.002	0.034	0.000	-0.008*	0.006	-0.003
	(0.005)	(0.004)	(0.130)	(0.003)	(0.004)	(0.004)	(0.003)
1st term FT	0.002	-0.001	0.125	0.002	-0.011***	0.008**	0.001
	(0.004)	(0.004)	(0.111)	(0.003)	(0.004)	(0.003)	(0.003)
2nd term FT	0.007*	0.004	0.110	0.004	-0.003	0.003	0.000
	(0.004)	(0.004)	(0.104)	(0.003)	(0.004)	(0.003)	(0.003)
3rd term FT	-0.001	0.003	-0.007	0.006*	-0.003	-0.001	-0.007**
	(0.004)	(0.003)	(0.099)	(0.003)	(0.003)	(0.003)	(0.003)
B - Impact of FT eligibility relative 3rd term of PT eligibility							
1st term FT	0.006	0.001	0.091	0.002	-0.003	0.002	0.004
	(0.004)	(0.004)	(0.108)	(0.003)	(0.003)	(0.003)	(0.003)
2nd term FT	0.011**	0.006	0.077	0.003	0.005	-0.002	0.003
	(0.005)	(0.005)	(0.133)	(0.004)	(0.004)	(0.004)	(0.003)
3rd term FT	0.003	0.005	-0.040	0.006	0.005	-0.006	-0.004
	(0.006)	(0.005)	(0.142)	(0.004)	(0.004)	(0.004)	(0.003)
C - Impact of FT eligibility relative to the previous FT term							
2nd term FT	0.005*	0.005*	-0.014	0.002	0.008**	-0.005***	-0.001
	(0.003)	(0.003)	(0.069)	(0.003)	(0.004)	(0.002)	(0.002)
3rd term FT	-0.008***	-0.001	-0.117*	0.002	0.000	-0.004**	-0.007***
	(0.003)	(0.003)	(0.064)	(0.002)	(0.003)	(0.002)	(0.002)
N observations	*275,917*	*275,917*	*273,821*	*273,821*	*273,821*	*273,821*	*275,917*
N mothers	*72,145*	*72,145*	*72,049*	*72,049*	*72,049*	*72,049*	*72,145*

Note: The sample includes mothers whose youngest child is aged between 0 and 6 and who are observed more than once. We include eligibility dummies for all children whether or not they are the youngest. All the regressions are linear regressions with mother-level fixed effects. They also control for the number of children in the age bands 0-2; 2-4; 5-9; 10-15 in the household, age-in-month dummies of the youngest child in the household as well as quarter of observation dummies, whether the mother has a partner and whether the child is eligible for a fourth or fifth term of part-time child care or a fourth to sixth term of full-time childcare. The reported effect of eligibility to free part-time education is for years after 2004 (when the policy was fully in place). Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table 5 - Effect on mothers' labour market outcomes of their youngest child's eligibility to free part-time and full-time childcare

	(1) In labour force	(2) In work	(3) Weekly hours	(4) >0 & <16 hours	(5) >=16 & <30 hours	(6) 30+ hours	(7) Looking for work
A - Impact relative to no eligibility							
1st term PT	0.003	-0.004	-0.063	-0.004	-0.004	0.003	0.003
	(0.004)	(0.004)	(0.121)	(0.004)	(0.006)	(0.004)	(0.004)
2nd term PT	0.010	0.000	-0.034	0.003	-0.01	0.007	0.006
	(0.008)	(0.006)	(0.192)	(0.006)	(0.008)	(0.006)	(0.006)
3rd term PT	0.021**	0.007	0.017	0.010	-0.01	0.008	0.01
	(0.011)	(0.008)	(0.272)	(0.008)	(0.010)	(0.008)	(0.008)
1st term FT	0.052***	0.019**	0.327	0.019**	-0.015	0.017	0.024**
	(0.011)	(0.010)	(0.350)	(0.009)	(0.014)	(0.011)	(0.010)
2nd term FT	0.074***	0.034***	0.594	0.021**	-0.006	0.020*	0.023**
	(0.013)	(0.011)	(0.406)	(0.011)	(0.015)	(0.012)	(0.011)
3rd term FT	0.078***	0.043***	0.827*	0.023*	-0.006	0.027**	0.015
	(0.015)	(0.013)	(0.455)	(0.012)	(0.017)	(0.013)	(0.011)
B - Impact of FT eligibility relative 3rd term of PT eligibility							
1st term FT	0.031***	0.012**	0.310	0.009	-0.005	0.009	0.014***
	(0.006)	(0.006)	(0.196)	(0.006)	(0.007)	(0.006)	(0.005)
2nd term FT	0.053***	0.026***	0.577**	0.011	0.004	0.012*	0.013**
	(0.008)	(0.008)	(0.273)	(0.008)	(0.009)	(0.007)	(0.006)
3rd term FT	0.057***	0.035***	0.810***	0.013	0.004	0.018**	0.005
	(0.011)	(0.010)	(0.338)	(0.009)	(0.012)	(0.009)	(0.007)
C - Impact of FT eligibility relative to the previous FT term							
2nd term FT	0.022***	0.015***	0.267***	0.003	0.008	0.003	-0.001
	(0.004)	(0.004)	(0.114)	(0.004)	(0.005)	(0.004)	(0.004)
3rd term FT	0.004	0.009**	0.233**	0.002	0.001	0.006**	-0.008***
	(0.005)	(0.004)	(0.118)	(0.004)	(0.005)	(0.003)	(0.003)
N observations	*275,917*	*275,917*	*273,821*	*273,821*	*273,821*	*273,821*	*275,917*
N mothers	*72,145*	*72,145*	*72,049*	*72,049*	*72,049*	*72,049*	*72,145*

Note: The sample includes mothers whose youngest child is aged between 0 and 6 and who are observed more than once. Estimates include eligibility dummies interacted with youngest and not youngest child status; results for youngest child are shown in the table, results for not-youngest are shown in Appendix Table A3. All the regressions are linear regressions with mother-level fixed effects. They also control for the number of children in the age bands 0-2; 2-4; 5-9; 10-15 in the household, age-in-month dummies of the youngest child in the household as well as quarter of observation dummies, whether the mother has a partner and whether the child is eligible for a fourth or fifth term of part-time child care or a fourth to sixth term of full-time childcare. The reported effect of eligibility to free part-time education is for years after 2004 (when the policy was fully in place). Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table 6 - Effect on fathers' labour market outcomes of their youngest child's eligibility to free part-time and full-time childcare

	(1) In labour force	(2) In work	(3) Weekly hours	(4) >0 & <16 hours	(5) >=16 & <30 hours	(6) 30+ hours	(7) Looking for work
A - Impact relative to no eligibility							
1st term PT	0.000	-0.004	-0.158	0.001	0.002	-0.006	0.003
	(0.003)	(0.004)	(0.220)	(0.002)	(0.003)	(0.004)	(0.004)
2nd term PT	0.001	-0.005	-0.171	0.001	0.002	-0.007	0.004
	(0.004)	(0.006)	(0.334)	(0.002)	(0.005)	(0.007)	(0.006)
3rd term PT	0.003	-0.004	-0.221	0.001	-0.001	-0.006	0.010
	(0.006)	(0.007)	(0.415)	(0.003)	(0.006)	(0.008)	(0.007)
1st term FT	0.005	-0.001	-0.029	0.001	-0.002	0.000	0.009
	(0.006)	(0.009)	(0.536)	(0.004)	(0.007)	(0.011)	(0.008)
2nd term FT	0.004	-0.002	0.140	0.001	-0.006	0.003	0.012
	(0.007)	(0.010)	(0.597)	(0.004)	(0.008)	(0.012)	(0.009)
3rd term FT	0.003	-0.002	0.226	0.002	-0.005	0.002	0.012
	(0.008)	(0.011)	(0.656)	(0.005)	(0.009)	(0.013)	(0.010)
B - Impact of FT eligibility relative 3rd term of PT eligibility							
1st term FT	0.002	0.004	0.191	0.000	-0.001	0.006	-0.001
	(0.003)	(0.005)	(0.256)	(0.002)	(0.004)	(0.006)	(0.004)
2nd term FT	0.001	0.002	0.361	0.000	-0.005	0.009	0.002
	(0.004)	(0.006)	(0.319)	(0.003)	(0.005)	(0.007)	(0.005)
3rd term FT	0.000	0.002	0.447	0.001	-0.004	0.008	0.002
	(0.006)	(0.007)	(0.392)	(0.003)	(0.006)	(0.009)	(0.006)
C - Impact of FT eligibility relative to the previous FT term							
2nd term FT	-0.001	-0.001	0.169	0.000	-0.004**	0.003	0.003
	(0.002)	(0.003)	(0.162)	(0.001)	(0.002)	(0.004)	(0.003)
3rd term FT	-0.001	0.000	0.086	0.001	0.001	-0.001	0.000
	(0.003)	(0.003)	(0.171)	(0.001)	(0.002)	(0.003)	(0.003)
N observations	*213,553*	*213,553*	*209,351*	*209,351*	*209,351*	*209,351*	*213,553*
N mothers	*56,207*	*56,207*	*55,926*	*55,926*	*55,926*	*55,926*	*56,207*

Note: See notes to Table 5 for details on specfication. The sample includes any observations on co-residential partners ('fathers') of the mothers in the sample.

Table 7 - Heterogeneity analysis: Effect on mothers' labour market outcomes of the youngest child's eligibility to free childcare

	(1) Partnership status		(2) Education		(3) Local unemployment		(4) Policy period			
	main effect	* mother has partner	main effect	* low education	main effect	* low unemp in LEA	main effect	2000-2003	2006-2009	2010-2013
A - Impact of eligibility relative to no eligibility on mothers' labour force participation										
1st term PT	0.008	-0.006	-0.005	0.018***	0.002	0.004	-0.003	-0.003	0.002	0.002
	(0.007)	(0.008)	(0.005)	(0.006)	(0.005)	(0.005)	(0.008)	(0.009)	(0.008)	(0.008)
2nd term PT	0.026**	-0.021**	0.007	0.007	0.011	-0.002	-0.007	0.004	0.009	0.010
	(0.012)	(0.010)	(0.008)	(0.007)	(0.009)	(0.007)	(0.008)	(0.008)	(0.008)	(0.009)
3rd term PT	0.034**	-0.017*	0.021*	0.001	0.020*	0.002	-0.006	0.007	0.008	0.020**
	(0.014)	(0.010)	(0.011)	(0.008)	(0.011)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)
1st term FT	0.071***	-0.025**	0.051***	0.003	0.054***	-0.005	0.030***			
	(0.015)	(0.012)	(0.012)	(0.009)	(0.012)	(0.009)	(0.008)			
2nd term FT	0.098***	-0.031**	0.071***	0.007	0.070***	0.011	0.050***		n/a	
	(0.018)	(0.015)	(0.013)	(0.010)	(0.013)	(0.010)	(0.009)			
3rd term FT	0.108***	-0.040***	0.076***	0.006	0.074***	0.01	0.054***			
	(0.019)	(0.015)	(0.015)	(0.010)	(0.015)	(0.012)	(0.012)			
B - Impact of eligibility relative to no eligibility on mothers' probability to be in work										
1st term PT	-0.006	0.003	-0.007	0.008	-0.004	0.001	-0.008	-0.003	0.002	0.005
	(0.006)	(0.006)	(0.005)	(0.006)	(0.004)	(0.004)	(0.007)	(0.008)	(0.007)	(0.007)
2nd term PT	0.006	-0.008	-0.001	0.002	-0.002	0.005	-0.012	0.004	0.001	0.017**
	(0.009)	(0.008)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)
3rd term PT	0.017	-0.012	0.01	-0.004	0.007	0.001	-0.012	0.005	0.008	0.023***
	(0.011)	(0.008)	(0.009)	(0.007)	(0.008)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
1st term FT	0.024*	-0.006	0.023**	-0.007	0.016	0.008	0.008			
	(0.012)	(0.009)	(0.011)	(0.009)	(0.010)	(0.009)	(0.006)			
2nd term FT	0.032**	0.003	0.041***	-0.014	0.026**	0.022**	0.022***		n/a	
	(0.015)	(0.012)	(0.013)	(0.010)	(0.012)	(0.010)	(0.008)			
3rd term FT	0.047***	-0.005	0.051***	-0.015	0.038***	0.012	0.031***			
	(0.017)	(0.012)	(0.015)	(0.010)	(0.014)	(0.011)	(0.011)			
N observations	275,917		275,602		275,893		275,917			

Note: See notes to Table 5 for details on specfication. Mothers are defined as having low educational qualifications if their highest qualification is below A-level. Mothers are defined as living in a low unemployment area if the unemployment rate in the Travel to Work Area (TTWA) in which they live is below the median unemployment rate across all TTWAs. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table 8 - Robustness checks: effect of youngest child's eligibility to free part-time and full-time childcare

	(1) Age controls: plus cubic in age of all children		(2) No mother FE		(3) Controlling for lone parent obligations		(4) Controlling for local availability of free nursery places	
	In labour force	In work	In labour force	In work	In labour force	In work	In labour force	In work
A - Impact relative to no eligibility								
1st term PT	0.003	-0.004	-0.001	-0.017**	0.003	-0.004	0.002	-0.005
	(0.004)	(0.004)	(0.008)	(0.008)	(0.004)	(0.004)	(0.005)	(0.005)
2nd term PT	0.01	-0.001	-0.007	-0.028**	0.01	0	0.01	-0.003
	(0.008)	(0.006)	(0.012)	(0.013)	(0.008)	(0.006)	(0.009)	(0.007)
3rd term PT	0.021**	0.007	-0.012	-0.033**	0.021**	0.007	0.019*	0.008
	(0.011)	(0.008)	(0.016)	(0.017)	(0.011)	(0.008)	(0.011)	(0.009)
1st term FT	0.052***	0.019*	0.000	-0.031	0.052***	0.019**	0.060***	0.028**
	(0.011)	(0.010)	(0.020)	(0.020)	(0.011)	(0.010)	(0.013)	(0.012)
2nd term FT	0.074***	0.033***	0.018	-0.019	0.074***	0.034***	0.083***	0.045***
	(0.013)	(0.011)	(0.022)	(0.022)	(0.013)	(0.011)	(0.015)	(0.014)
3rd term FT	0.077***	0.042***	0.013	-0.021	0.078***	0.043***	0.086***	0.054***
	(0.015)	(0.013)	(0.023)	(0.023)	(0.015)	(0.013)	(0.017)	(0.016)
B - Impact of FT eligibility relative 3rd term of PT eligibility								
1st term FT	0.031***	0.012**	0.013	0.002	0.031***	0.012**	0.040***	0.020***
	(0.006)	(0.006)	(0.011)	(0.011)	(0.006)	(0.006)	(0.008)	(0.007)
2nd term FT	0.053***	0.026***	0.030***	0.014	0.053***	0.026***	0.064***	0.037***
	(0.008)	(0.008)	(0.012)	(0.013)	(0.008)	(0.008)	(0.011)	(0.010)
3rd term FT	0.057***	0.035***	0.025*	0.012	0.057***	0.035***	0.066***	0.046***
	(0.011)	(0.010)	(0.013)	(0.015)	(0.011)	(0.010)	(0.014)	(0.012)
C - Impact of FT eligibility relative to the previous FT term								
2nd term FT	0.022***	0.015***	0.018***	0.012***	0.022***	0.015***	0.024***	0.017***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
3rd term FT	0.004	0.009**	-0.005	-0.002	0.004	0.009**	0.002	0.009*
	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)
N observations	*275,917*	*275,917*	*292,488*	*292,488*	*275,917*	*275,917*	*208,691*	*208,691*
N mothers	*72,145*	*72,145*	*-*	*-*	*72,145*	*72,145*	*55,178*	*55,178*

Note: See notes to Table 5 for details on specfication. Results in column (1) use age bands and control for a cubic in the age in days of up to six youngest children in the family. Results in column (2) are without mother fixed effects and include a cubic in mother's age, mother's ethnic group, highest educational qualification and a dummy for a new baby in the family as additional controls. Results in column (3) include a policy dummy for the loss of entitlement to unconditional welfare benefits for some lone parents in the sample. Results in coulmn (4) control for the availability of free part-time childcare places at local authority level measured as the proportion of three-year-olds in a local authority with a free childcare place. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Appendix Tables

Table A1 - Average childcare use by age of youngest child

Age of youngest child:	0	1	2	3	4	5
Any childcare						
Any use	0.380	0.620	0.710	0.820	0.900	0.890
	(0.007)	(0.008)	(0.008)	(0.007)	(0.006)	(0.007)
Weekly hours of childcare	5.381	12.711	14.785	19.096	30.292	31.428
	(0.174)	(0.254)	(0.285)	(0.317)	(0.413)	(0.413)
Formal, subsidisable care						
Any use of subsidisable childcare	0.106	0.302	0.476	0.696	0.808	0.788
	(0.005)	(0.007)	(0.008)	(0.009)	(0.008)	(0.009)
Weekly hours of subsidisable childcare	1.142	4.656	6.642	11.273	22.739	23.587
	(0.079)	(0.158)	(0.185)	(0.216)	(0.340)	(0.288)
Weekly spend on subsidisable childcare	4.661	20.092	26.161	22.242	11.603	1.188
	(0.385)	(0.799)	(0.867)	(0.890)	(0.706)	(0.287)
Formal, non-subsidisable care						
Any use	0.03	0.076	0.087	0.085	0.133	0.193
	(0.003)	(0.004)	(0.005)	(0.005)	(0.007)	(0.008)
Weekly hours	0.553	1.638	1.932	1.335	1.597	1.363
	(0.060)	(0.105)	(0.127)	(0.105)	(0.114)	(0.092)
Informal care						
Any use	0.300	0.430	0.430	0.420	0.410	0.410
	(0.007)	(0.008)	(0.008)	(0.007)	(0.006)	(0.007)
Weekly hours	3.686	6.417	6.210	6.488	5.955	6.478
	(0.141)	(0.187)	(0.199)	(0.226)	(0.236)	(0.302)

Note: Standard errors of the means are reported in parentheses. Summary statistics are based on all children who are the youngest in their families in England in the FRS for 2005-2013. The sample size is 19,565. Spending expressed in 2012 £. Subsidisable care includes day nurseries, infant and primary schools; informal care includes unregistered childminders, friends and non-parental relatives. The final category of "formal, non-subsidisable care" is not shown here.

Table A2 - Effect of youngest child's eligibility to free part-time and full-time childcare on childcare use (for that particular child)

	(1)	(2)	(3)	(4)	(5)	(5)
		Subsidisable care		Other formal	Informal	Any
	Any use	Wkly hrs	Wkly spend	Wkly hrs	Wkly hrs	childcare

A - Impact relative to no eligibility

1st term PT	0.0898***	2.892***	-8.620**	0.0779	-3.501***	-0.531
	(0.034)	(1.026)	(4.151)	(0.451)	(1.048)	(1.468)
2nd term PT	0.077*	1.867	-6.314	0.127	-3.36**	-1.366
	(0.045)	(1.378)	(5.156)	(0.734)	(1.407)	(1.965)
3rd term PT	0.134***	2.491	-4.521	0.688	-3.584**	-0.405
	(0.050)	(1.605)	(5.832)	(0.895)	(1.767)	(2.319)
1st term FT	0.216***	2.526	-16.22**	-0.715	-1.452	0.359
	(0.058)	(2.148)	(6.363)	(1.022)	(1.992)	(2.990)
2nd term FT	0.231***	3.452	-14.25**	-0.737	-0.455	2.26
	(0.063)	(2.183)	(6.742)	(1.067)	(2.085)	(3.111)
3rd term FT	0.251***	4.196*	-13.71**	-0.741	-0.0145	3.44
	(0.064)	(2.288)	(6.897)	(1.118)	(2.330)	(3.329)

B - Impact of FT eligibility relative 3rd term of PT eligibility

1st term FT	0.0823**	0.0348	-11.7***	-1.403**	2.133**	0.764
	(0.037)	(1.559)	(4.522)	(0.708)	(1.041)	(1.935)
2nd term FT	0.097**	0.961	-9.732*	-1.426*	3.13***	2.665
	(0.042)	(1.749)	(5.173)	(0.798)	(1.204)	(2.259)
3rd term FT	0.117***	1.704	-9.189*	-1.429*	3.57***	3.845
	(0.042)	(1.772)	(4.841)	(0.807)	(1.275)	(2.417)

C - Impact of FT eligibility relative to the 1st FT term

2nd term FT	0.0145	0.926	1.97	-0.0224	0.997	1.9*
	(0.019)	(0.790)	(2.057)	(0.388)	(0.750)	(1.153)
3rd term FT	0.02	0.743	0.543	-0.00383	0.44	1.18
	(0.017)	(0.640)	(1.762)	(0.303)	(0.821)	(1.104)

Note: The sample is children aged 2 to 7 at the time of the interview, living in families in England interviewed between April 2005 and March 2013 (N= 11,187). We include different eligibility dummies for the youngest child and other children, and only report here the ones for the youngest child. All the regressions are linear regressions and they also control for the age of the child in month dummies, age and educational qualifications of the main carer and partner (if present), an indicator for whether the mother is married or cohabiting, a dummy for whether the child is the only child, Local Authority dummies, and a dummy indicating whether the Local Authority of residence operated a school admission policy whereby children start school the September after they turn 4. We also control for the age of other children in the household in the age bands 0-2; 2-4; 5-9; 10-15 in the household. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table A3 - Effect on mothers' labour market outcomes of their not youngest child's eligibility to free part-time and full-time childcare

	(1) In labour force	(2) In work	(3) Weekly hours	(4) >0 & <16 hours	(5) >=16 & <30 hours	30+ hours	(7) Looking for work
Impact relative to no eligibility							
1st term PT	-0.002	-0.003	0.106	0.000	-0.010**	-0.010**	-0.002
	(0.005)	(0.004)	(0.100)	(0.004)	(0.004)	(0.004)	(0.003)
2nd term PT	0.008	0.006	0.367***	0.003	-0.011**	-0.011**	0.001
	(0.006)	(0.005)	(0.124)	(0.004)	(0.005)	(0.005)	(0.004)
3rd term PT	0.001	0.001	0.188	0.001	-0.010*	-0.010*	-0.002
	(0.006)	(0.005)	(0.142)	(0.005)	(0.006)	(0.006)	(0.004)
1st term FT	0.003	0.005	0.359***	0.002	-0.011**	-0.011**	-0.003
	(0.005)	(0.005)	(0.129)	(0.004)	(0.004)	(0.004)	(0.003)
2nd term FT	0.005	0.006	0.203*	0.002	-0.002	-0.002	-0.002
	(0.004)	(0.004)	(0.112)	(0.004)	(0.004)	(0.004)	(0.004)
3rd term FT	-0.001	0.001	-0.089	0.005*	-0.001	-0.001	-0.005*
	(0.004)	(0.003)	(0.100)	(0.003)	(0.003)	(0.003)	(0.003)
Difference youngest to not youngest child							
1st term PT	0.005	-0.001	-0.169	-0.003	0.006	-0.004	0.005
	(0.007)	(0.006)	(0.160)	(0.005)	(0.007)	(0.006)	(0.005)
2nd term PT	0.002	-0.007	-0.401**	0.000	0.001	-0.009	0.005
	(0.010)	(0.007)	(0.204)	(0.007)	(0.009)	(0.007)	(0.007)
3rd term PT	0.020*	0.007	-0.171	0.010	0.000	-0.003	0.012
	(0.011)	(0.009)	(0.275)	(0.009)	(0.010)	(0.009)	(0.009)
1st term FT	0.049***	0.013	-0.031	0.017*	-0.004	0.003	0.027***
	(0.012)	(0.010)	(0.359)	(0.010)	(0.014)	(0.012)	(0.010)
2nd term FT	0.069***	0.028***	0.391	0.019*	-0.004	0.015	0.025***
	(0.014)	(0.011)	(0.378)	(0.011)	(0.016)	(0.012)	(0.010)
3rd term FT	0.079***	0.041***	0.915**	0.018	-0.005	0.03	0.020*
	(0.015)	(0.013)	(0.420)	(0.012)	(0.017)	(0.013)	(0.011)
N observations	275,917	275,917	273,821	273,821	273,821	273,821	275,917
N mothers	72,145	72,145	72,049	72,049	72,049	72,049	72,145

Note: See notes to Table 5. Estimates include eligibility dummies interacted with youngest and not youngest child status, here we report results for the not youngest child's eligibility.

Table A4 - Effect on fathers' labour market outcomes of their not youngest child's eligibility to free part-time and full-time childcare

	(1) In labour force	(2) In work	(3) Weekly hours	(4) >0 & <16 hours	(5) >=16 & <30 hours	30+ hours	(7) Looking for work
Impact relative to no eligibility							
1st term PT	-0.003	-0.002	-0.211	0.000	0.003	-0.004	-0.003
	(0.002)	(0.003)	(0.182)	(0.001)	(0.003)	(0.004)	(0.003)
2nd term PT	-0.002	-0.002	-0.275	-0.001	0.005	-0.005	-0.003
	(0.003)	(0.004)	(0.195)	(0.001)	(0.004)	(0.004)	(0.003)
3rd term PT	-0.002	0.000	0.009	-0.001	0.001	0.002	-0.005
	(0.002)	(0.004)	(0.211)	(0.002)	(0.003)	(0.005)	(0.003)
1st term FT	-0.002	0.005	0.14	0.001	0.001	0.002	-0.007*
	(0.002)	(0.004)	(0.191)	(0.002)	(0.003)	(0.004)	(0.004)
2nd term FT	-0.006**	-0.001	-0.198	0.002	-0.005*	0.003	-0.003
	(0.002)	(0.003)	(0.163)	(0.001)	(0.003)	(0.004)	(0.003)
3rd term FT	-0.002	-0.002	-0.145	0.001	0.000	-0.003	0.000
	(0.002)	(0.003)	(0.143)	(0.001)	(0.002)	(0.003)	(0.003)
Difference youngest to not youngest child							
1st term PT	0.002	-0.002	0.053	0.001	-0.002	-0.002	0.006
	(0.004)	(0.005)	(0.295)	(0.002)	(0.004)	(0.006)	(0.005)
2nd term PT	0.003	-0.002	0.104	0.002	-0.003	-0.002	0.007
	(0.005)	(0.007)	(0.388)	(0.003)	(0.005)	(0.008)	(0.006)
3rd term PT	0.004	-0.005	-0.23	0.002	-0.002	-0.008	0.015*
	(0.006)	(0.008)	(0.468)	(0.004)	(0.006)	(0.009)	(0.008)
1st term FT	0.007	-0.005	-0.169	0.000	-0.003	-0.002	0.016*
	(0.007)	(0.009)	(0.560)	(0.004)	(0.008)	(0.011)	(0.009)
2nd term FT	0.01	-0.001	0.338	-0.001	-0.001	0.000	0.015*
	(0.007)	(0.010)	(0.608)	(0.005)	(0.008)	(0.012)	(0.009)
3rd term FT	0.005	0.000	0.371	0.001	-0.005	0.005	0.012
	(0.008)	(0.011)	(0.657)	(0.005)	(0.009)	(0.013)	(0.010)
N observations	275,917	275,917	273,821	273,821	273,821	273,821	275,917
N mothers	72,145	72,145	72,049	72,049	72,049	72,049	72,145

Note: See notes to Table 5 for details on specfication. The sample includes any observations on co-residential partners ('fathers') of the mothers in the sample. Estimates include eligibility dummies interacted with youngest and not youngest child status, here we report results for the not youngest child's eligibility.

Table A5 - Heterogeneity analysis: effect on mothers' working hours of the youngest child's eligibility to free childcare

	(1) Partnership status						(2) Education					
	>0 & <16 hours		>=16 & <30 hours		30+ hours		>0 & <16 hours		>=16 & <30 hours		30+ hours	
	main effect	* mother has partner	main effect	* mother has partner	main effect	* mother has partner	main effect	* low education	main effect	* low education	main effect	* low education
1st term PT	-0.001	-0.003	-0.008	-0.008	0.003	0.000	-0.003	-0.001	-0.009	0.012**	0.005	-0.002
	(0.005)	(0.004)	(0.006)	(0.006)	(0.005)	(0.004)	(0.005)	(0.005)	(0.007)	(0.005)	(0.005)	(0.004)
2nd term PT	0.005	-0.002	-0.006	-0.006	0.007	0.000	0.004	0.000	-0.016*	0.012*	0.011	-0.008
	(0.007)	(0.006)	(0.009)	(0.009)	(0.007)	(0.005)	(0.007)	(0.006)	(0.009)	(0.007)	(0.007)	(0.006)
3rd term PT	0.01	0.001	-0.001	-0.001	0.007	0.001	0.013	-0.005	-0.016	0.013*	0.013	-0.010
	(0.010)	(0.007)	(0.011)	(0.011)	(0.010)	(0.006)	(0.009)	(0.007)	(0.011)	(0.007)	(0.010)	(0.007)
1st term FT	0.011	0.01	0.002	0.002	0.012	0.007	0.025**	-0.012	-0.025*	0.021**	0.026**	-0.017**
	(0.011)	(0.008)	(0.014)	(0.014)	(0.012)	(0.008)	(0.011)	(0.009)	(0.015)	(0.009)	(0.012)	(0.008)
2nd term FT	0.013	0.012	0.004	0.004	0.016	0.006	0.027**	-0.011	-0.015	0.016	0.031**	-0.021**
	(0.013)	(0.009)	(0.017)	(0.017)	(0.013)	(0.009)	(0.012)	(0.010)	(0.016)	(0.011)	(0.013)	(0.008)
3rd term FT	0.020	0.004	0.004	0.004	0.023*	0.005	0.032**	-0.017*	-0.019	0.025**	0.040***	-0.025***
	(0.014)	(0.009)	(0.019)	(0.019)	(0.014)	(0.010)	(0.013)	(0.009)	(0.018)	(0.011)	(0.014)	(0.009)
Number of obs.	275,917						275,602					
Number of mothers	72,049						71,930					

Note: See notes to Table 5 for details on specfication. Mothers are defined as having low educational qualifications if their highest qualification is below A-level. Mothers are defined as living in a low unemployment area if the unemployment rate in the Travel to Work Area (TTWA) in which they live is below the median unemployment rate across all TTWAs. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table A6 - Additional robustness checks for heterogeneity analysis of the effect on mothers' labour market outcomes of their youngest child's eligibility to free part-time and full-time childcare

	(1) Controlling for lone parent obligations		(2) Controlling for local availability of free nursery places			
	main effect	* partner	main effect	2000-03	2006-09	2010
A - Impact of eligibility relative to no eligibility on mothers' labour force participation						
1st term PT eligibility	0.008	-0.006	-0.005	-0.004	0.002	0.007
	(0.007)	(0.008)	(0.008)	(0.009)	(0.008)	(0.015)
2nd term PT eligibility	0.026**	-0.021**	-0.01	0.003	0.01	0.02
	(0.012)	(0.010)	(0.008)	(0.008)	(0.008)	(0.014)
3rd term PT eligibility	0.034**	-0.017*	-0.01	0.008	0.011	0.030**
	(0.014)	(0.010)	(0.009)	(0.008)	(0.009)	(0.014)
1st term FT eligibility	0.070***	-0.024*	0.031***			
	(0.016)	(0.012)	(0.008)			
2nd term FT eligibility	0.097***	-0.030**	0.053***			
	(0.018)	(0.015)	(0.011)			
3rd term FT eligibility	0.107***	-0.039**	0.055***			
	(0.019)	(0.015)	(0.014)			
B - Impact of eligibility relative to no eligibility on mothers' probability to be in work						
1st term PT eligibility	-0.006	0.003	-0.01	-0.004	0.002	0.015
	(0.006)	(0.006)	(0.007)	(0.008)	(0.007)	(0.012)
2nd term PT eligibility	0.006	-0.008	-0.013*	0.003	0.001	0.019
	(0.009)	(0.008)	(0.007)	(0.007)	(0.008)	(0.013)
3rd term PT eligibility	0.017	-0.012	-0.012	0.007	0.01	0.026**
	(0.011)	(0.008)	(0.007)	(0.007)	(0.007)	(0.013)
1st term FT eligibility	0.025**	-0.007	0.009			
	(0.013)	(0.009)	(0.007)			
2nd term FT eligibility	0.033**	0.002	0.026***			
	(0.015)	(0.012)	(0.009)			
3rd term FT eligibility	0.048***	-0.006	0.034***			
	(0.017)	(0.012)	(0.012)			
N observations	*275,917*		*208,691*			

Note: See notes to Table 5 for details on specfication. Results in column (1) include a policy dummy for the loss of entitlement to unconditional welfare benefits for some lone parents in the sample and interactions with having a partner. Results in column (2) control for the availability of free part-time childcare places at local authority level, measured as the proportion of three-year-olds in a local authority with a free childcare place and interacted with policy period.