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Does more free childcare help parents work more?

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Abstract

Many governments are considering expanding childcare subsidies, but little is known about the impact of such policies on parent's labour supply. Exploiting free childcare eligibility rules based on date of birth in a difference-in-differences framework, we compare the effects of offering free part-time childcare and of expanding this offer to the whole school day. Free part-time childcare only affects the labour force participation of mothers whose youngest child is eligible. Expanding from part-time to full-time free childcare leads to significant increases in labour force participation and employment of these mothers, which emerge immediately and grow over the months following entitlement.

JEL codes: I21, J22

Keywords: Labour supply, childcare, school entry, difference-in-difference

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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]

There is, however, little empirical evidence available on the question of whether increasing the generosity and/or flexibility of childcare subsidies leads parents to work more, and it is unclear how much we can learn about these questions from the large empirical literature investigating the impact of offering free or subsidised childcare compared with offering nothing. This is because the parents who are affected are likely to be different in each case, and hence may have different labour supply responses. The subsidies may also have non-linear effects on parental employment.

This paper sheds new light on this important issue by evaluating the impact on parents' labour supply of initially offering pre-school children in England free, half-day childcare and then increasing this free offer to the whole of the school day. This allows us to analyse the impact both of offering 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. Our data also spans a period in which policy changes increased the flexibility with which the part-time subsidy could be used, so we can assess how important flexibility seems to be for the labour supply response.

This evidence is not only highly policy relevant in a context where many countries have expanded or are considering expanding subsidies, but may also provide new insight into why some studies have found that the childcare subsidies implicit in pre-school or school eligibility have little or no impact on parental labour supply (e.g. Fitzpatrick, 2010; 2012). It is often suggested that such results are consistent with the downward trend in female labour supply elasticity found in the recent literature (Blau and Kahn, 2007; Heim, 2007), but an alternative explanation might be that the way in which the subsidies are delivered is too inflexible and that they often do not cover a full work day. Our paper sheds new light on the extent to which this might be a credible explanation for these results.

[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 existing offer of free childcare for 3 and 4 year olds was expanded from 15 to 30 hours per week for working families living in England from September 2017.

To identify the causal effect of free childcare on parental labour supply, we exploit date-of-birth rules governing children's entitlement to free part-time and full-time education places. These rules mean that children gain entitlement to free care at different points in the year and at different ages. Specifically, 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 most children are eligible to start full-time school in the September after they turn four. These features give us considerable variation in both the timing and duration of entitlement to part-time and full-time care by children's birth month, and we provide evidence that they are highly relevant for the take-up of formal childcare.

Our empirical strategy exploits these eligibility rules along with the longitudinal nature of our data to implement an individual-level difference-in-differences strategy, which compares the change in parents' labour market outcomes as their children's entitlement to free care changes between parents of children born in different months of the year. In contrast to much of the previous literature, we have access to exact date of birth of all children living in the household, and the fact that we observe parents repeatedly means that we can assess the extent to which parents' behavioural responses to the different childcare subsidies change with the duration of exposure. We also estimate impacts for both mothers and fathers.

We estimate the intention-to-treat effect of being eligible for free part-time and full-time childcare on parents' labour market outcomes, which is the relevant parameter reflecting the total benefit of the policy. 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 not eligible for free care. These effects are only apparent during the period in which the part-time offer could be used more flexibly. We find no effects for fathers or for mothers whose eligible child is not the youngest in any policy period. This small labour supply response is consistent with a separate analysis on a different household survey that records children's use of childcare. There, we find that the entitlement to free part-time childcare increases the amount of time that children spend in any form of childcare very little, crowding out both paid-for formal childcare and informal care.

We find a greater impact of free full-time childcare on maternal labour supply: in the first term of full-time entitlement the probability of being in the labour force is 3.1 percentage points higher and the probability of working is 1.1 percentage points higher than in the third term of free part-time childcare. Moreover, these impacts increase with time, such that, by the end of the first year of full-time entitlement, 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. These impacts are solely concentrated amongst mothers with no younger children. Consistent with these stronger effects for mothers with no younger children, we find evidence that the rise in the use of subsidisable childcare following entitlement to full-time free childcare does not entirely 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, 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 or availability of formal childcare.[2] 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]

[2] Most of the recent studies exploiting such policy changes estimate the impact of these policies in a reduced-form framework. However, there are a few exceptions, such as Bernal (2008), Bernal and Keane (2010) and Chan and Liu (2017), which exploit these sources of variation to estimate structural or quasi-structural models of maternal labour supply and child care choices in order to understand the impact of child care policies on life-cycle decisions of women and cognitive development of children.

[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

The existing empirical literature offers a wide range of estimates of the impact of the introduction of both part-time and full-time childcare subsidies on maternal labour supply. As noted by Bauernschuster and Schlotter (2015) and Cattan (2016), both the generosity of the subsidy and the context in which subsidies are introduced are important drivers of the magnitude of their impact on labour supply, with larger impacts generally found for more generous policies introduced 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.

Given this heterogeneity in findings, it is not straightforward to infer the likely impact of introducing part-time or full-time free childcare in England from existing estimates. It is also not clear whether we can infer anything about the likely impact of *extending* entitlement to free childcare from estimates of the impact of introducing part-time or full-time childcare. 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. Moreover, amongst parents who are already in work, extending the subsidy would have *a priori* ambiguous effects on the number of hours worked, as its impact would depend on the relative strengths of the income and substitution effects for different parents. Thus, even in contexts where the introduction of childcare subsidies did encourage some parents to work or work longer hours, it is not clear that extending them further would yield any further increase in labour supply.

To our knowledge, there are only a few studies that estimate the impact of increasing the childcare subsidy on offer. Berthelon et al. (2015) exploit geographical variation in adoption of a policy to increase the length of the primary school day in Chile from about 5.5 to 7.5 hours. Using a difference-in-differences approach in a panel data setting, their results show that a 10 percentage point increase in the percentage of children in a municipality attending a school offering the longer length day raised maternal employment by 2.5 percentage points in the year of exposure. However, the female labour force participation rate in Chile was among the lowest in the world at around 35% at the time of the expansion of full-time places (compared with around 60% during the period of interest in England), and the focus is on the effect of extending childcare subsidies for older children, whose impact could be quite different from the impact of extending subsidies for pre-schoolers. Moreover, this study does not distinguish the effects by duration since entitlement.

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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). See Cattan (2016) for a recent assessment of the literature.

Lundin et al. (2008) assess the impact on mothers of children aged 1-9 of introducing a price cap on already highly subsidised childcare which more than halved the average hourly rate from 14.7 SEK (USD1.75 or GBP 1.22 at today's rates). In a setting with very high labour supply among mothers of pre-school children (around 80%) and extensive use of public childcare, these changes led to increased attendance mostly among children of unemployed parents and parents on parental leave, and no impact on mothers' employment and hours of work (amongst those who are working).[4] By contrast, the policies we examine were introduced in a setting where the labour supply of mothers of pre-school children is much lower and they have a considerably higher monetary value, as they reduced the (marginal) price of the subsidised hours to zero. These differences in the type of subsidy being extended, for which families, and in the context of vastly differing rates of labour force participation and formal childcare usage make it difficult to draw firm conclusions about the likely effect of extending childcare subsidies to the UK context. Both studies also focus solely on the impact on mothers' labour supply.

Our paper adds to this existing literature in at least three distinct ways. First**,** it offers evidence of the impact on both mothers and fathers' labour supply of increasing the provision of free childcare from half-day to full-day care amongst children under five. This contrasts with the vast majority of existing studies on this topic, which focus on mothers only and either study the impact of offering subsidised or free childcare compared to offering nothing or else consider the impact of extending childcare subsidies for older children. We also test for heterogeneous effects across a number of subgroups (e.g. by partnership status and education), which is important given the likely heterogeneity in gains from selecting into childcare and into the labour market (Cornelissen et al., 2016).

Second, our paper estimates separate impacts for each term of entitlement to free part-time and full-time childcare – that is, we allow the impact to vary by duration of exposure. In doing so, we add to a small set of papers interested in the dynamics of mothers' labour market behaviour following receipt of a childcare subsidy (Brewer and Crawford, 2010, Lefebvre et al., 2009, Nollenberger and Rodriguez-Planas, 2015). We show that accounting for dynamics matters for our understanding of the effect of these policies, as a model imposing equal coefficients throughout the year following entitlement to free part-time or full-time childcare is strongly rejected by the data. This is important

[4] Cannon et al. (2006) estimate the impact of attending full-day kindergarten versus half-day kindergarten on maternal work using data from the Early Child Longitudinal Study-Kindergarten Class of 1998-1999. To address parental selection into full-day versus half-day kindergarten, they use state (but not time) variation in policies on full-day kindergarten programs as an instrument for the likelihood that a student will attend a full-day program. However, they warn that their results should be viewed with caution given that they find only mixed evidence suggesting the validity of their instruments.

because most 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 regression discontinuity 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).

A third contribution is that we provide suggestive evidence of the importance of the flexibility with which free childcare can be taken up for its impact on parental labour supply. At the beginning of the time-period covered by our data, free part-time childcare could only be taken in the form of a set number of hours each week day. Subsequent policy changes enabled the available hours to be taken more flexibly (across three rather than five week days, alongside a slight increase in generosity), potentially making it easier to cover (a small number of) full working days. To our knowledge previous papers have been unable to study the effects of such flexibility, although lack of flexibility is a candidate explanation for the low impact of pre-school or school eligibility on parental labour supply found in recent US studies (for example Fitzpatrick, 2010; 2012).

3. Institutional background

3.1 Childcare policy in England

In the late 1990s the UK had a relatively low maternal employment rate: only 57% of mothers of children aged 0-6 were in work, and this proportion was lower for lone mothers (40% in work) and low educated mothers (44% in work).[5] Together with the perception that childcare was not affordable for many families, this 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).[6]

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 (available throughout the UK). Second, a scheme to allow employers to pay childcare

[5] Source: author's calculations based on the Quarterly Labour Force Survey for 1992 to 2000.

[6] 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.

vouchers that are free of personal income tax and social insurance contributions (also available throughout the UK). Third, in England only (although other counties in the UK have similar policies), 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).[7] 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 between the age of 4 and 5, as we discuss later). 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 entitlement 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. As a result of the free entitlement, the overall fraction of children accessing a free place rose from 42% in 2000 to 82% in 2004 and 94% in 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).

This policy does not involve government directly providing, or even contracting to provide, additional childcare places. Instead, parents can use their entitlement either in one of a limited number of state-run childcare settings (in which all childcare is provided free of charge) or in a childcare facility run by the private sector.[8] Only in private nurseries can parents pay for additional hours on top of their entitlement. As Blanden et al. (2016) show, when the free entitlement was first introduced in 2000,

[7] 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).

[8] The existence of these 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, and these use the same date-of-birth admission rules as the ones we exploit in this paper. Because the variation we exploit in this paper is by age and term of birth rather than by policy period, the existence of state-run institutions does not affect the interpretation of our results. We do however focus on the period from 2004 when estimating the impact of eligibility for free part-time childcare because places for 3-year-olds were only universally available from that year.

most three-year-olds (82%) were already attending some type of pre-school education. About 40% of them attended publicly-provided free childcare, and the rest purchased places in private settings. Between 2000 and 2004 the increased demand for childcare triggered by the free entitlement led to more places being created in the private sector. Throughout the roll-out of the free entitlement, the share in (free-to-access) public facilities did not change. Rather the impact of the policy was to increase the share of 3-year-olds in private facilities now receiving a full rebate on their first 15 hours. In this sense, the free entitlement can be seen as effectively acting as a price subsidy, rather than as a policy that increased the availability of childcare places as is often studied in other countries.

Crucial to our identification of policy impacts are the various discontinuities in eligibility caused by date-of-birth admission rules applied in both state-run and private childcare providers. Children become eligible for a free part-time childcare place at the start of the academic term after they turn three (well after statutory maternity leave ends when the child turns one). 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 free part-time childcare into their fourth year of life 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 about 6.5 hours a day, or 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.[9] Parents do

[9] 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

not have to send their child to school earlier than the statutory school age, but the vast majority of children do start school in the September after they turn four.[10]

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 across those born in different months of the year in both the age at which children become entitled to full-time care and the number of terms of part-time care that they can receive. For example, children born one day apart on 31 August and 1 September 2011 would be eligible for a 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). This also means that children born on 31 August are only eligible to receive three terms of part-time care before starting full-time education, whereas children born on 1 September are eligible for five terms of free part-time care before starting school. (And spring-borns are eligible for four terms of free part-time childcare.)

Figure 1 illustrates the variation in access to free part-time and full-time childcare created by the different eligibility rules for children born in six different sample months of the year. It shows the ages at which these children become eligible for their first, second, third, and for some children fourth and fifth, terms of part-time childcare, and the ages at which they become eligible for different terms of full-time care. At roughly the same age, children can be in adjacent treatments, depending on their birth month, which we exploit to estimate the impact of entitlement to different types of free care on the labour supply of their parents. We elaborate further on this in our empirical strategy section below.

4. Data and empirical strategy

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, where households are interviewed in up to five consecutive quarters and then replaced.

Our sample from the LFS includes any mother or father interviewed between 2000 and 2013 with at least one child living in the household and aged 0 to 6 at the time of the interview.[11] We drop families

encouraged local authorities to allow parents to start school at the beginning of the school year after their child has turned four.

[10] 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.

for whom we do not observe key characteristics, such as the date of birth of their children. 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. 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 are unlikely to bias our results. Although the exact sample size varies slightly with the outcome of interest, we end up working with a sample of about 72,000 mothers and 56,000 fathers of children between the ages of 0 and 6.

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 (defined as those with less than A-levels, a group that is the equivalent of those without 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 rates do not change at all with the age of the youngest child, hovering around 95% and 91% respectively.

4.2 Empirical strategy

Our aim is to estimate the impacts on parental labour market outcomes of children's eligibility for free part-time and full-time childcare. These are intention-to-treat (ITT) parameters, since they measure the effect of *being offered* free childcare rather than the effect of *using* free childcare, and they are the relevant parameters for computing the total benefits of the policy. Specifically, we define our treatment as whether *any* child in the household is eligible for part-time or full-time childcare. This contrasts with most of the related literature (with the exception of Lundin et al., 2008), which instead estimates the impact of a particular (often the youngest) child's entitlement to childcare on maternal

[11] To be precise, in the LFS, relationships between individuals living in the same household are defined relative to the head of household. As a result, we define a respondent as a mother (father) if the head of household or spouse/cohabiting partner of the head of the household is a female (male) and if there is a child living in the household who is the head of household's natural son/daughter or step son/daughter.

labour supply. We choose to model parental labour supply at the parent-level rather than at the child-level to allow for the more realistic possibility that parents choose their labour supply as a function of all of their children's ages and eligibility for different types of free childcare. We do, however, allow the effect of entitlement to free childcare to differ for children who are and are not the youngest in their family.

To identify the treatment effect, we exploit differences in eligibility for different types of free childcare between children of the same age. Figure 1 illustrates the relevant variation by showing the eligibility for childcare for children of the same age and born in six exemplary months of the year. In the data, we observe children born in all 12 months of the year and use comparisons across all children. For example, shortly after a child turns three, children born in August, December and March will be eligible for their first term of part-time care, and others will not yet be entitled to anything. Children born in September, January and April are those who have to wait the longest before gaining eligibility. Shortly after turning four, August-borns are eligible for their first term of full-time care, September-, January- and April-borns are eligible for their third term of part-time care, and December- and March-borns are eligible for their fourth term of part-time care. Although there is no age at which we observe children with all possible entitlements to free childcare, it is the case that, for every possible age in months from 36 to 60, we observe children in between two and four different possible entitlement statuses. This does, however, mean that it is important to control flexibly for the age of children in the family, and we describe later how we do that.

To operationalise this variation and estimate the effect of eligibility for part-time (PT) and full-time (FT) childcare, a natural starting point would be to estimate the following equation in a cross-section:

$$Y_{i,A,M} = \pi^{PT} EligPT_{i,A,M} + \pi^{FT} EligFT_{i,A,M} + \beta' X_{i,A,M} + \delta_A + \rho_M + \varepsilon_{i,A,M}, \quad (1)$$

where $Y_{i,A,M}$ is a labour supply outcome of parent i of J children of age $A = (a_1, \dots, a_J)$ and born in months M $=(m_1, \dots, m_J)$, where a_k and m_k refer to the age and month of birth of the k^{th} youngest child, respectively; $EligPT_{i,A,M}$ and $EligFT_{i,A,M}$ are binary indicators for whether parent i has any child who is eligible for free, part-time childcare and free, full-time childcare, respectively; $X_{i,A,M}$ is a vector of individual-level controls relating to the parent (e.g. education, partnership status, ethnicity); δ_A is a vector of age controls for each child in the household, and ρ_M is a vector of month-of-birth fixed effects for each child in the household. Note that for the moment the above specification forces the effect of eligibility for part-time or full-time care to be the same regardless of the time elapsed since first becoming eligible.

In equation (1), identification of π^{PT} and π^{FT} relies on appropriately controlling for any differences between parents whose children are born at different points throughout the year and therefore become entitled to childcare at different points of the year. This is non-trivial: studies such as Buckles and Hungerman (2013) have found that 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). With cross-sectional data, purging the estimated values of π^{PT} and π^{FT} of these time-invariant differences would only be possible through the inclusion of the relevant observable controls ($X_{i,A,M,t}$ and ρ_M).

With longitudinal data on the other hand, we can capture all time-invariant differences between parents whose children are born in different months of the year through the inclusion of parent fixed effects. The estimating equation becomes:

$$Y_{i,A,M,t} = \pi^{PT} EligPT_{i,A,M,t} + \pi^{FT} EligFT_{i,A,M,t} + \beta' \tilde{X}_{i,A,M,t} + \delta_{A,t} + \sigma_t + \alpha_i + \varepsilon_{i,A,M,t} \qquad (2)$$

where we have added a subscript t to refer to the (calendar) time period of the observation and reflect the fact that we observe the same parent in several time periods. Here, σ_t are time effects (i.e. year or quarter dummies), α_i is an individual parent fixed effect, which subsumes the child month of birth effect ρ_M and any time-invariant variables from the vector $X_{i,A,M,t}$, and any remaining time-varying variables are included in $\tilde{X}_{i,A,M,t}$.

With panel data and hence the inclusion of parent fixed effects, our empirical strategy can be described as an individual-level difference-in-differences approach, where we compare the within-parent changes in labour market outcomes as children move into different treatments between parents whose children are born in different months and therefore become eligible for free childcare at different ages.[12] The identifying assumption is weaker than with cross-sectional data since it only requires that the labour supply of parents whose children are born in different months of birth does not vary in time-varying ways that we cannot control for. Specifically, the Fixed Effect (FE) estimates of the parameters $\hat{\pi}^{PT}$ and $\hat{\pi}^{FT}$ are unbiased estimates of π^{PT} and π^{FT} as long as $E\left(\varepsilon_{i,A,M,t} \middle| \tilde{X}_{i,A,M,t}, \delta_{A,t}, \sigma_t, \alpha_i\right) = 0$. In our empirical implementation of the model, $\tilde{X}_{i,A,M,t}$ includes an

[12] We note that a similar strategy combining date-of-birth discontinuities and longitudinal data has been used in the literature looking at impacts of school starting age on children's short and long-term outcomes (see Black et al. (2011) for example).

indicator for whether parent *i* has a partner at the time of the interview and σ_t includes a set of quarter and year of interview dummies to capture seasonal labour market effects.[13]

As mentioned earlier, we are particularly interested in estimating separate impacts for different terms of eligibility in order to assess how parental responses to the subsidies evolve with the duration of the subsidy. A model that restricts the impact of entitlement to be the same across all terms, as in equation (2) above, would not capture these dynamics, so to enrich it we allow the effect of entitlement to part-time and full-time care to depend on the term of entitlement, with our preferred specification being the following parent-level equation:

$$Y_{i,A,M,t} = \sum_{\tau=1}^{5} \pi_{\tau}^{PT} EligPT_{A,M,t,\tau} + \sum_{\tau=1}^{3} \pi_{\tau}^{FT} EligFT_{A,M,t,\tau} + \beta' X_{i,A,M,t} + \delta_{A,t} + \sigma_t + \alpha_i + \varepsilon_{i,A,M,t} \quad (3)$$

where $EligPT_{A,M,t,\tau}$ and $EligFT_{A,M,t,\tau}$, are binary indicators for whether parent *i* at time *t* has any child who is in the τ-th term of entitlement for free part-time childcare and free full-time childcare respectively. τ varies from one to up to five terms for part-time care and from one to up to three terms for full-time care. As we discuss in the results section below, we will test for equality of the coefficients π_{τ}^{PT} and for equality of the coefficients π_{τ}^{FT} across terms of eligibility. We will strongly reject the restrictive specification, thus suggesting that allowing for such dynamics matters. Note that our approach has the advantage of allowing us to estimate separate treatment effects for each term of part-time care and of full-time entitlement although we do not have sufficient observations in our data to support separate regression discontinuity estimates of each treatment.

Given that the indicators of entitlement to free part-time and full-time childcare depend on the interaction of the children's age with their term of birth, we need to control for the ages of all the children in the family so as not to confound the impact of entitlement to free care with the (generally positive) impact that children growing older has on parental labour supply. Our preferred specification for this age function $\delta_{A,t}$ includes 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 years, 2-4 years, 5-9 years and 10-15 years. But as we will show, our estimates are robust to alternative ways of controlling for children's ages, including using a cubic polynomial in the age in days of each child and using age in months for each of the three youngest children in the household.[14]

[13] Given the fact that we observe households for only up to five quarters, year dummies are identified off those households that we observe in two consecutive years.

[14] 93% of the families in the sample have fewer than four children under the age of 19 living in the household.

We estimate equation (3) above for two main labour market outcomes: binary indicators for the mother's (and father's) labour force participation and employment status. We also present further results where we look at whether parents are engaging in job search whilst unemployed or inactive, and different measures of labour supply at the intensive margin.[15] 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 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.[16]

Finally, as mentioned above, our data spans the period between 2000 and 2013. The free part-time entitlement was fully implemented only from 2004, so we interact all our part-time eligibility dummies with a 'pre 2004' indicator and report only the main effects estimated for the post 2004 period. In heterogeneity analysis we further distinguish effects by different policy periods that made the free part-time entitlement more generous and/or more flexible. In robustness checks we restrict our sample to 2004-2013 and examine whether capacity constraints related to the availability of places and anticipation effects drive our results.

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

In equation (3), the vectors π_τ^{PT} and π_τ^{FT} capture the impacts of being offered different types of free childcare on mothers' labour supply. 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 three and free full-time schooling at age four do affect the take-up of childcare in reality.

[15] Specifically, we estimate the model for 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. Specifically, lone parents have to work at least 16 hours per week in order to be entitled to support via a working tax credit, and there is another bonus paid to families with children whose combined working time exceeds 30 hours a week. The outcomes relating to hours of work take a value of zero if the parent is not in work. The job search outcome takes a value of zero if the parent is in work. Finally, we also use indicators for self-employment and for being in education as outcomes.

[16] 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. If the parent changes LA during the period of observation, we use the modal 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 on request).

To demonstrate the validity of this assumption, we use repeated cross-sections from the Family Resources Survey (FRS) to estimate the effect of eligibility for free part-time and full-time childcare on measures of childcare use at the child level.[17] The cross-sectional nature of the FRS necessitates that we estimate a version of equation (3) 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:

$$C_{i,a,m,t} = \sum_{\tau=1}^{5} \gamma_{\tau}^{PT} EligPT_{i,a,m,t,\tau} + \sum_{\tau=1}^{3} \gamma_{\tau}^{FT} EligFT_{i,a,m,t,\tau} + \beta' X_{i,a,m,t} + \delta_{a,t} + \rho_m + \sigma_t + \varepsilon_{i,a,m,t} \quad (4)$$

where $C_{i,a,m,t}$ is a variable measuring use of childcare by child *i* at age *a*, born in month *m* and observed at time *t*, the vector $X_{i,a,m,t}$ includes a set of permanent and time-varying characteristics about the mother, father and children in the household[18] and all other covariates ($\delta_{a,t}$, $\rho_m$and σ_t) 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. As such, we cannot rule out that unobserved maternal characteristics are similarly important for childcare use and therefore refrain from giving a strong causal interpretation to these results.[19]

We estimate equation (4) for different measures of childcare use - specifically on whether a child accesses any of a particular type of childcare, as well as the number of hours per week of each type of care used. We do this for any type of care provided outside the immediate family, and separately for subsidisable care (i.e. care provided by the sorts of establishments where parents can take up their

[17] 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 5.5 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.

[18] These include 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 in which all children start full-time education in the September after they turn four.

[19] We explored the possibility of using pseudo-cohort methods to allow for mother- or child-level fixed effects in equation (4), 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. In Section 6, we do use the FRS estimates to present back-of-the-envelope calculations of this parameter, keeping in mind that the first stage estimates may be biased.

entitlement to free part-time childcare)[20] 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 these outcome variables vary by the age of the youngest child.

Table 3 reports our estimates of equation (4) for all children.[21] The top panel displays the impact of eligibility for part-time childcare at various points in time relative to no eligibility, and the bottom panel the impact of eligibility for full-time childcare at various points in time relative to the third term of part-time entitlement (when children born in any term of the year are still eligible).

Column (1) provides strong evidence that becoming eligible for free part-time childcare increases the likelihood of using subsidisable care, and that this likelihood rises further when a child becomes eligible for free full-time childcare. Specifically, the use of subsidisable care increases by 14 percentage points by the third term of part-time eligibility and increases by another 11 percentage points by the third term of full-time eligibility. However, there is little evidence that this rise in the use of subsidisable care means that children are spending more time in childcare overall: Columns (3) and (4) show that there is no change in the likelihood of using any form of childcare outside the immediate family in response to the offer of free part-time or full-time childcare, and only a small increase in the number of hours used per week when children become entitled to free full-time childcare. This suggests 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, especially during the first three terms of part-time entitlement.

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

5. 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 force participation and work, respectively for fathers and mothers and separately for parents whose youngest child is eligible – where we expect to see the largest effects – and parents whose non-youngest child is eligible. Table 4 shows that fathers' labour supply is

[20] These will typically be day nurseries and also state-run infant or primary schools

[21] Results focusing on youngest children only are shown in Appendix Table A2 and are similar to those for all children.

unaffected by the provision of free childcare, thus the rest of our discussion focuses on the results for mothers.

5.1 Impact of entitlement to free part-time childcare

The top panel of Table 5 reports the effect of eligibility for free part-time childcare (relative to no free childcare) in each term of entitlement and overall (across all five terms).[22] There is little evidence that entitlement to free part-time childcare allows more mothers to move into work. There is some evidence that it enables some mothers to enter the labour force, though this is true only for mothers whose youngest child becomes eligible for free part-time care, and the estimates become statistically significant only in the third term of part-time entitlement, when we estimate that eligibility for free part-time childcare increases labour force participation by 2.1 percentage points (3.4% of the baseline), with effects of a similar magnitude in the fourth and fifth terms of entitlement.

As discussed in Section 3, however, 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. When the policy was first introduced, 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 (rather than being restricted to a maximum of 3 hours per day), potentially making it easier for families to combine with work.

The results in Table 5 estimate the average effect of being entitled to free part-time childcare across these various policy incarnations. To investigate whether these changes in the offer of free part-time childcare have affected the labour supply response of parents, we also ran a specification in which we allowed the impact of eligibility for free part-time childcare to be different across four periods: before 2004 (before the policy was universal), in 2004 and 2005, in 2006 to 2009, and from 2010.

Table 6 reports the results from this model. Column 3 highlights that there is no difference in the effects of entitlement to free part-time childcare between 2004 and 2009, suggesting that increasing the number of weeks of free part-time childcare available (from 33 to 38 weeks, as in 2006) does not seem to have facilitated maternal labour force participation in a significant way. By contrast, Column 4 shows that there is a significant difference between the labour force participation effects found in 2004/2005 and 2010 onwards, with the results suggesting that the positive effects on labour force

[22] These overall effects are weighted averages of the termly effects, where the weights are the proportion of observations contributing to each termly effect.

participation found in the third term of entitlement to part-time care are entirely driven by the post-2010 period. A positive and significant effect on the likelihood of being in work, of similar magnitude, is also observed during this period.

These results suggest that providing more, and more flexible, hours of free childcare facilitates mothers' labour supply. While we cannot identify separately the effects of the small increase in hours per week from the offer of greater flexibility, the fact that we found little impact of being offered 12.5 hours of free care per week, plus the fact that there is no evidence that increasing the number of weeks of free part-time childcare available helps mothers to participate in the labour force, suggests that the post-2010 effect might be driven by the increase in flexibility rather than the increase in hours. We are also able to rule out the possibility that these results are driven by a general increase in labour demand following the financial crisis; by a complete elimination of constraints on the availability of part-time nursery places (which gradually expanded over the course of the 2000s); or by the introduction of job search criteria for lone mothers that occurred during this period.[23]

5.2 Impact of increasing entitlement from free part-time to full-time childcare

As discussed earlier, one innovation of this paper is our ability to assess the empirical impact of increasing entitlement to free childcare to a greater extent – effectively doubling the amount of free childcare available from around 3 to around 6.5 hours per day – an impact whose direction is *a priori* ambiguous. We can in principle compare the impact of eligibility for the first, second and third terms of full-time care (and the impact of all three terms collectively) to the impact of eligibility for any term of part-time care, though in the middle panel of Table 5, we do so relative to the third term of part-time care, as this is the last term in which all children are entitled to free part-time childcare.[24]

Despite finding significant effects on the use of subsidisable childcare for all children, regardless of whether they were the youngest in their family, we continue to find no evidence of significant labour

[23] To rule out that the 2010-13 effects are driven by a post financial crisis recovery, we re-estimate the model controlling for the contemporaneous local unemployment rate and find that the results do not change. To rule out that these effects reflect the elimination of constraints on the supply of free part-time childcare places for 3-year-olds, we control for the proportion of 3-year-olds for whom a funded place is available in the local authority of residence of the mother in each year and again find that the results do not change. To rule out the possibility that the results are driven by the introduction of job-search conditions, backed up by sanctions, for lone parents claiming welfare benefits at around the same time as the policy became more flexible, thus plausibly increasing the labour supply of this group for reasons unrelated to childcare availability, we follow Avram et al. (2016) and include a policy dummy that is set to 1 beginning 12 months before the estimated loss of entitlement to the unconditional welfare benefit, and again find no change to our results. The results controlling for all three additional covariates can be found in Appendix Table A3. Results controlling for each additional covariate separately suggest very similar results and are available from the authors on request.

[24] Appendix Table A4 presents the estimates of the first, second and third terms of full-time entitlement relative to no entitlement, as well as to the fourth and fifth terms of part-time entitlement. The results relative to the fourth and fifth terms of part-time entitlement are broadly similar to those discussed here.

supply effects for mothers whose non-youngest child becomes eligible for full-time childcare. This could be explained by the fact that, in order to work, mothers with additional younger children would still have to pay for childcare for their non-eligible younger children and such costs would negatively affect their labour supply.

We do, however, find significant effects on mothers whose youngest child becomes entitled to free full-time care: increasing the childcare subsidy from around 3 to around 6.5 hours a day increases the probability of these mothers being in the labour force and of being in paid work. 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 than in the third term of entitlement to part-time care, with around one third of these mothers finding work, such that the probability of being in work is 1.1 percentage points higher in the first term of free full-time entitlement than in the third term of free part-time care.

These impacts of access to full-time childcare also grow throughout the first three terms of entitlement. The bottom panel of Table 5 shows the impact of the second and third terms of full-time entitlement relative to the first term of full-time entitlement (and of the third term of entitlement relative to the second). 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, estimates which are significantly higher than those found in the first term of full-time entitlement. Interestingly, Appendix Table 5 shows that these effects arise primarily as a result of mothers in lower unemployment areas entering the labour market and finding work.[25]

Appendix Table 6 shows that this rise in employment increases hours worked by an average of 0.8 hours per week by the third term of entitlement, with an increase in the proportion of mothers working 'short' part-time jobs (of 1-15 hours per week) as well as full-time jobs (of at least 30 hours per week). This suggests that entitlement to free full-time childcare may increase the hours of work of mothers with greater attachment to the labour market (who would be in work in the absence of the subsidy) and at the same time encourages some mothers to move into 'short' part-time work.

[25] Lower unemployment areas are defined as those with an unemployment rate below the national median in the "Travel To Work Area" (commuting zone) of residence. We also test for heterogeneity in effects for mothers with and without a partner, and for those with higher and lower educational qualifications. The point estimates suggest that the effects are smaller for mothers with lower education, and that the labour market participation effects are lower (but the employment effects higher) for mothers with partners, suggesting that these mothers are more likely to find a job conditional on looking than mothers without partners. None of these differences are statistically significant, however.

The dynamic effects we find suggest that it may take some time for mothers to enter the labour market and find a suitable job - as evidenced by the significant effects shown in Appendix Table 6 on the proportion of mothers looking for work when they initially become entitled to free full-time childcare – thus emphasising the importance of looking beyond the very short-term effects of the free entitlement when evaluating the effect of this and similar policies on labour supply. Our results also indicate that a model which forces the effect to be the same across all terms of entitlement (as in equation 2) is mis-specified. This is particularly true for full-time eligibility, where the effects are significantly different from zero and where equality of coefficients across all terms of full-time eligibility is strongly rejected for both labour force participation and the likelihood of being in work.[26]

5.3 Specification and robustness checks

We conduct a variety of checks on our estimates, focusing on the results for mothers with no younger children, as this is the only group for which we found any significant effects.

The importance of mother fixed effects A strength of our research design is that we exploit both longitudinal data and eligibility rules governing access to free childcare to identify the impact of free childcare eligibility on maternal labour supply. To illustrate the importance of including mother fixed effects in our case, we re-estimate our main specification omitting mother fixed effects and instead including time-invariant covariates or those that would be collinear in a fixed effects specification, including a cubic in mother's age, mother's ethnic group, mother's highest educational qualifications, month of birth dummies for the youngest child, and a dummy for a new youngest child appearing in the household during the period of observation. The results of this model are reported in Column 1 of Table 7 and show that the inclusion of mother fixed effects matters substantially. Indeed, the results without mother fixed effects underestimate the effect of the policy, suggesting that mothers of children born at different times of the year have unobserved time-invariant characteristics such as preferences for births in a particular season that also affect labour market outcomes. This highlights 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.

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 isolate accurately the effect of the policy on maternal labour supply. Our main specification controls for the age of the youngest child

[26] The p-value of a joint test that all π_τ^{PT} coefficients (for $\tau = 1, \dots, 5$) for the youngest child is 0.292 (0.236) for labour force participation (in work). This is unsurprising given that most of these coefficients are insignificantly different from zero. The p-value of a joint test that all π_τ^{FT} coefficients (for $\tau = 1, \dots, 3$) for the youngest child is 0.000 (0.001) for labour force participation (in work).

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. The remainder of Table 7 reports the results of three such specifications. In Column (2) we add cubic controls for the age in days of up to the next six youngest children in the household (in addition to our baseline age controls). Column (3) displays results when adding age in month dummies for the second youngest child to our baseline age controls, and Column (4) when adding age in month dummies also for the third youngest child. Looking across these models, estimates of the impact of entitlement to free part-time and full-time childcare remain remarkably stable and are almost identical to the main results reported in Table 5, reassuring us that age effects are not driving our results.

Capacity constraints Our next robustness check tests whether our results are affected by capacity constraints, which may be a particular problem for our estimates of the effect of entitlement to free part-time childcare. These constraints might arise in two ways. First, children born in different terms of the year may face differential chances of securing a place at nursery. This is because nursery places in England tend to become available from September, the month that most children start full-time schooling and therefore vacate places in nurseries. This is also the month that summer-born children first become entitled to free part-time childcare. This could imply that by the time autumn- and spring-born children become eligible for free part-time places later in the year, those vacated in September are taken up.[27] Such capacity constraints could weaken the labour supply responses of parents to the free part-time childcare offer. If this were true, it would be more likely that it did so for parents of autumn- and spring-born children than for parents of summer-born children. We investigate whether this is the case by estimating a very flexible specification in which we allow the impact of each term of eligibility for part-time care to vary with the child's term of birth and then test whether the impacts are equal across all terms of birth. We report these estimates in the first three columns of Table 8 and the p-value of the tests in the fourth column. Results show that we cannot reject that the impact of each term of entitlement is the same across mothers whose youngest child is born in different terms, suggesting that this type of capacity constraint is not leading us to underestimate the effect of entitlement to part-time childcare on maternal labour supply.

[27] Our sample size in the FRS is too small to estimate the impact of eligibility on the take-up of childcare separately by term of birth, but analysis of administrative data on the take-up of free part-time childcare places suggests that summer-born children are more likely to have access to places in state-funded settings – where this is likely to be a particular problem – than those born in the autumn or spring.

The second reason capacity constraints could affect the impact of free part-time childcare is that, over the period covered by our data (2000-2013), the legal entitlement to a free childcare place for 3-year-olds was only introduced in 2004. Moreover, although places should have been universally available from 2004, full coverage of funded places was not achieved until about 2007 (see Blanden et al. (2016) who exploit this feature to identify effects of childcare availability on child outcomes). In the presence of such capacity constraints we would expect to underestimate the impact of childcare eligibility. To check whether our estimates of the impact of entitlement to free part-time childcare might be downward-biased, we add controls for the availability of funded places in the mothers' local authority of residence. These results are reported in the fifth column of Table 8. The estimated impacts of entitlement to part-time care are very similar for labour force participation and the probability of being in work to those in our baseline specification. In a further robustness check, we also restrict our analysis to the period 2004-2013 and find very similar results.[28] This suggests that capacity constraints are not significantly downward-biasing our estimates of the impact of entitlement to part-time care.

Anticipation effects One of the main contributions of this paper is to estimate the impact of increasing the amount of free childcare from part-time to full-time. Because the age at which full-time care is available is known to parents in advance, it is possible that their responses to the availability of part-time care are affected by the future availability of full-time care. If such responses were important, then this would limit our ability to make inferences about the impact of increasing the amount of free care. The direction of bias is unclear, however. Parents eligible for part-time childcare may still take up work in the knowledge that they will soon receive free full-time care. Alternatively, the fact that parents know they will be entitled to free full-time care later may delay their return to work because the cost of working now is higher relative to the cost of working later. In the first case, our strategy would lead us to underestimate the true impact of increasing entitlement from part-time to full-time care. In the second case, it would lead us to overestimate it.

Empirically, if anticipation effects were important, then we would expect the impact of (say) the third term of eligibility for part-time care to differ between mothers whose children will become eligible for full-time care in the next term (the mothers of summer-borns) and those who have to wait for two or three more terms until full-time eligibility begins (the mothers of spring- or autumn-borns respectively). In other words, we would expect the effects to differ by term of birth. The results in Table 8 (discussed above) suggest that this is not the case: the p-values shown in Column 4 indicate that we cannot reject the hypothesis that the effect of different terms of entitlement to part-time care is

[28] Results available from the authors on request.

the same for children born in different terms. This suggests that anticipation effects are unlikely to be driving our results.

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 access to both free part-time and free full-time childcare and hence of extending entitlement to free care from part-time to full-time. 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 along with panel data. Our individual-level difference-in-differences strategy implicitly compares the labour supply of parents of children born in all months of the year, but also allows us to control for time-invariant differences between these parents by including parent fixed effects. This approach allows us to estimate multiple treatment effects (that is, the impact of part-time care and of full-time care, where these impacts are allowed to vary with duration of exposure) in a situation where we do not have sufficient observations in our data to support separate regression discontinuity estimates of each treatment.

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 57%. 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 or 3 hours a day of free childcare was too weak an incentive to encourage many new mothers to join the labour force, though our results suggest that increasing the flexibility with which parents can take up this offer seems to have produced a small labour supply response.

Viewed across the entire observation period, the part-time entitlement did allow a few mothers already in work to switch from part-time to full-time work, but for most the policy 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 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, our estimates imply that the impact of free full-time childcare in England is roughly similar to those found in Spain (Nollenberger and Rodriguez-Planas, 2015), thus standing in between the very small 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 free part-time and full-time childcare policies that we have studied may not have been more effective at increasing parental labour supply. 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 policies had a large crowding out effect on the use of other types of childcare, and that the income effect may dominate the substitution effect for many parents. Nonetheless, our estimates suggest that the implicit effect of *using* subsidisable childcare on maternal labour supply could be substantial. Indeed, if we use the FRS analysis as our best indication of the "first stage" impact of offering free childcare on subsidisable childcare use to scale up our ITT estimates from the LFS, we estimate that the impact of starting to use subsidisable childcare in response to being offered free part-time care could boost maternal labour force participation by as much as 18 percentage points by the third term of entitlement to part-time care for mothers whose youngest child is eligible. Similarly, starting to use subsidisable childcare in response to being offered free full-time care drives up labour force participation by 52 percentage points and employment by 35 percentage points by the third term of full-time entitlement for mothers whose youngest child becomes eligible.[29]

The second reason why the childcare policies we study may not have had larger impacts on parental labour supply is that 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 full-time childcare is offered to children aged 0 to 5, in England the universal entitlement to a free part-time childcare place starts at age 3 and children do not start school (and hence become entitled to a free full-time childcare place) until age 4. 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 6.5 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

[29] To compute the effect of using subsidisable childcare on maternal labour force participation of mothers whose youngest child is eligible for part-time care, we divide the effect of part-time eligibility on maternal labour force participation in the third term of eligibility (0.021, as reported in the top panel of Table 5) by the corresponding effect of part-time eligibility on the use of subsidisable childcare in the third term of eligibility (0.117, see Appendix Table A2). For the same back-of-the-envelope calculation using the coefficients relating to the third term of full-time eligibility relative to the third term of part-time eligibility, we divide the effect on maternal labour force participation (0.057, as reported in Table 5) and on maternal employment (0.035, as reported in Table 5) in these terms by the effect on the use of subsidisable childcare (0.11, see Appendix Table A2) in these terms.

policies' 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, there are obviously 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: Terms of entitlement to free part-time (PT) and free full-time (FT) of children born in sample months of the year

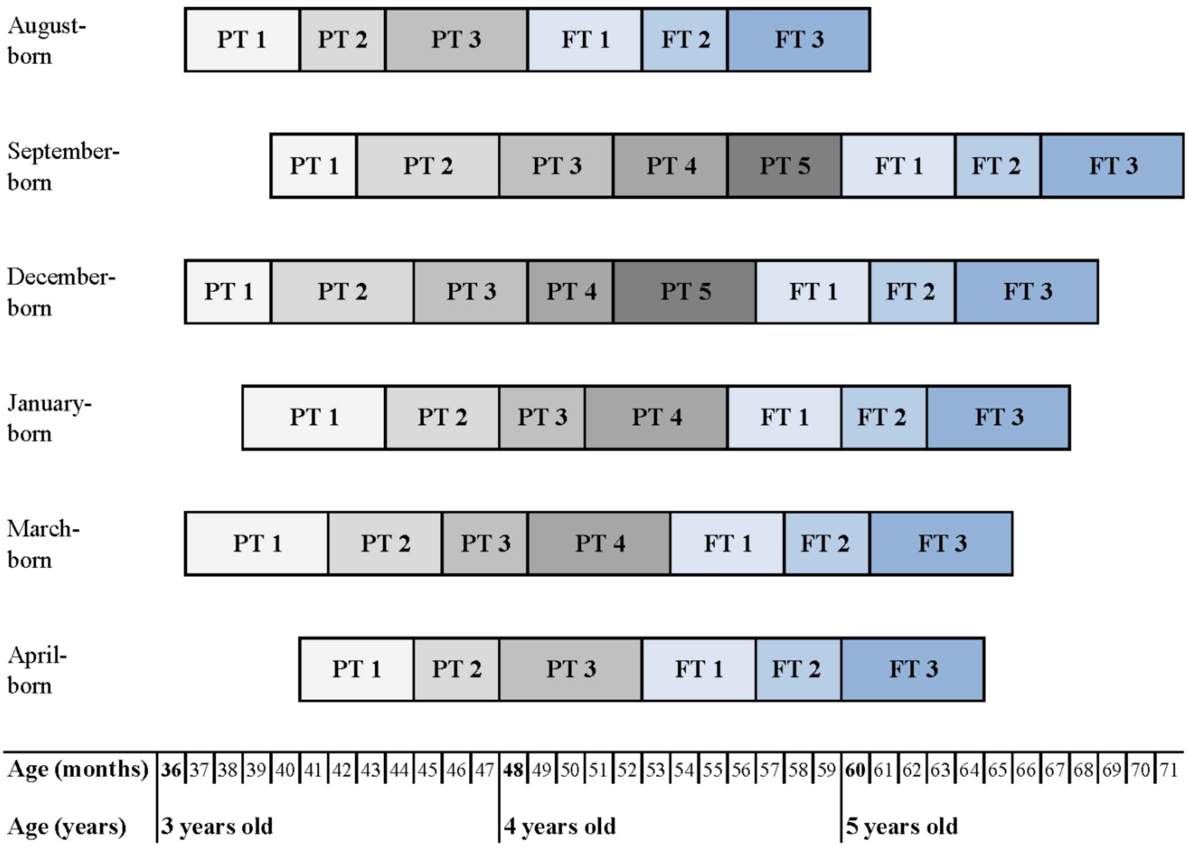

Table 1 - Descriptive statistics of the initial and final samples

	(1) Initial sample			(2) Final sample after sampling decisions		
	Mean	Std. dev.	N	Mean	Std. dev.	N
Sample of mothers						
In labour force	0.610		*296,866*	0.614		*276,018*
In work	0.568		*296,866*	0.572		*276,018*
Works 1-15 hrs/wk	0.107		*294,536*	0.109		*273,920*
Works 16-29 hrs/wk	0.237		*294,536*	0.24		*273,920*
Works 30+ hrs/wk	0.220		*294,536*	0.218		*273,920*
Usual weekly hours	14.305	(15.281)	*294,536*	14.319	(15.212)	*273,920*
Looking for work	0.049		*296,866*	0.049		*276,018*
Age	33.064	(6.070)	*294,830*	33.107	(6.037)	*276,018*
Has a partner	0.773		*296,866*	0.777		*276,018*
Non white	0.150		*296,341*	0.144		*275,984*
Low education (< A-levels)	0.507		*296,262*	0.502		*275,703*
Number of kids under 19	1.976	(0.992)	*296,866*	1.978	(0.988)	*276,018*
Age of youngest child	2.193	(1.676)	*295,617*	2.203	(1.655)	*276,018*
Sample of fathers						
In labour force	0.951		*229,498*	0.953		*213,637*
In work	0.909		*229,498*	0.912		*213,637*
Works 1-15 hrs/wk	0.007		*224,803*	0.007		*209,433*
Works 16-29 hrs/wk	0.038		*224,803*	0.037		*209,433*
Works 30+ hrs/wk	0.862		*224,803*	0.866		*209,433*
Usual weekly hours	38.403	(15.597)	*224,803*	38.525	(15.451)	*209,433*
Looking for work	0.041		*229,498*	0.04		*213,637*
Age	36.447	(6.499)	*228,052*	36.488	(6.460)	*213,637*
Has a partner	1.000		*229,498*	1.000		*213,637*
Non white	0.146		*229,099*	0.14		*213,613*
Low education (< A-levels)	0.407		*228,098*	0.402		*212,657*
Number of kids under 19	1.971	(0.966)	*229,498*	1.973	(0.960)	*213,637*
Age of youngest child	2.112	(1.668)	*228,611*	2.122	(1.647)	*213,637*

Notes: Sample consists of mothers and fathers with a child aged 0-6 between January 2000 and December 2013.

Table 2 - Average parental 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 - In work			
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 for free part-time and full-time childcare on use of childcare

	(1)	(2)	(3)	(4)	(5)	(6)
	Subsidisable care		Any care		Informal care	
	Any use	Weekly	Any use	Weekly	Any use	Weekly
Part-time eligibility						
1st term	0.0962***	1.991***	0.00604	-1.289	-0.113***	-2.967***
	(0.0259)	(0.631)	(0.0253)	(1.156)	(0.0344)	(0.889)
2nd term	0.084***	1.259	-0.0019	-2.018	-0.136***	-3.165***
	(0.0376)	(1.034)	(0.0353)	(1.651)	(0.0468)	(1.159)
3rd term	0.141***	1.645	-0.00839	-2.171	-0.174***	-4.042***
	(0.0426)	(1.284)	(0.0434)	(1.934)	(0.0639)	(1.477)
4th term	0.180***	2.582	-0.00441	-0.411	-0.138*	-2.286
	(0.0528)	(1.654)	(0.0536)	(2.496)	(0.076)	(1.693)
5th term	0.209***	2.822	0.00247	-0.0623	-0.126	-2.441
	(0.0602)	(2.138)	(0.0552)	(2.968)	(0.0861)	(2.015)
Average effect	0.130***	1.900*	-0.00156	-1.436	-0.140***	-3.144**
	(0.0362)	(1.061)	(0.036)	(1.664)	(0.0515)	(1.224)
Full-time eligibility relative to 3rd term of part-time eligibility						
1st term	0.0789***	2.650**	0.00971	2.031	-0.00359	0.334
	(0.0292)	(1.187)	(0.0249)	(1.616)	(0.0395)	(0.840)
2nd term	0.0871***	3.452***	0.0358	3.127*	0.0442	0.568
	(0.0324)	(1.325)	(0.0295)	(1.835)	(0.0522)	(1.032)
3rd term	0.112***	4.173***	0.0235	3.874*	0.00436	0.475
	(0.036)	(1.37)	(0.0312)	(2.078)	(0.0546)	(1.143)
Average effect	0.0945***	3.481***	0.0222	3.070*	0.0122	0.453
	(0.0318)	(1.251)	(0.0274)	(1.800)	(0.0464)	(0.959)
No. observations			*17,151*			

Note: The sample includes children aged 2 to 5.5 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, child's month of birth 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. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

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

	(1)	(2)	(3)	(4)
	In labour force		In work	
	Youngest child	Non-youngest child	Youngest child	Non-youngest child
Part-time eligibility				
1st term	-0.001	-0.002	-0.004	-0.002
	(0.003)	(0.002)	(0.004)	(0.003)
2nd term	0.001	-0.002	-0.005	-0.003
	(0.004)	(0.003)	(0.006)	(0.004)
3rd term	0.003	-0.001	-0.005	0.000
	(0.006)	(0.002)	(0.007)	(0.004)
4th term	-0.001	-0.002	0.000	0.000
	(0.007)	(0.004)	(0.009)	(0.005)
5th term	0.004	-0.006	-0.002	-0.005
	(0.007)	(0.004)	(0.009)	(0.005)
Average effect	0.001	-0.002	-0.004	-0.002
	(0.004)	(0.002)	(0.006)	(0.010)
Full-time eligibility relative to 3rd term of part-time eligibility				
1st term	0.002	0.000	0.004	0.005
	(0.003)	(0.002)	(0.005)	(0.004)
2nd term	0.001	-0.004	0.002	-0.001
	(0.004)	(0.003)	(0.006)	(0.004)
3rd term	0.000	0.000	0.001	-0.002
	(0.006)	(0.003)	(0.007)	(0.004)
Average effect	0.001	-0.001	0.002	0.000
	(0.004)	(0.002)	(0.006)	(0.003)
Dynamic effects				
2nd term FT - 1st term FT	-0.001	-0.004	-0.002	-0.005
	(0.002)	(0.002)	(0.003)	(0.003)
3rd term FT - 2nd term FT	-0.001	0.004	-0.001	-0.001
	(0.003)	(0.002)	(0.003)	(0.003)
3rd term FT - 1st term FT	-0.002	0.000	-0.002	-0.007
	(0.004)	(0.002)	(0.005)	(0.004)
N observations	*213,637*			
N fathers	*56,226*			

Note: The sample includes fathers with at least one child 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 father-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 and whether the child is eligible for 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 child's eligibility for free part-time and full-time childcare

	(1)	(2)	(3)	(4)
	In labour force		In work	
	Youngest child	Non-youngest child	Youngest child	Non-youngest child
Part-time eligibility				
1st term	0.003	-0.003	-0.004	-0.003
	(0.004)	(0.005)	(0.004)	(0.004)
2nd term	0.011	0.006	0.000	0.005
	(0.008)	(0.006)	(0.006)	(0.005)
3rd term	0.021**	-0.001	0.008	-0.001
	(0.011)	(0.006)	(0.008)	(0.005)
4th term	0.023**	0.006	0.015	0.006
	(0.011)	(0.008)	(0.009)	(0.007)
5th term	0.025*	0	0.014	0.011
	(0.013)	(0.008)	(0.011)	(0.008)
Average effect	0.014*	0.004	0.001	0.003
	(0.008)	(0.003)	(0.005)	(0.004)
Full-time eligibility relative to 3rd term of part-time eligibility				
1st term	0.031***	0.002	0.011*	0.004
	(0.006)	(0.005)	(0.006)	(0.005)
2nd term	0.053***	0.004	0.026***	0.004
	(0.008)	(0.007)	(0.008)	(0.006)
3rd term	0.057***	-0.001	0.035***	0.001
	(0.011)	(0.006)	(0.010)	(0.006)
Average effect	0.047***	0.001	0.024***	0.003
	(0.008)	(0.006)	(0.004)	(0.008)
Dynamic effects				
2nd term FT - 1st term FT	0.022***	0.003	0.015***	0
	(0.004)	(0.004)	(0.004)	(0.003)
3rd term FT - 2nd term FT	0.004	-0.005*	0.009***	-0.004
	(0.005)	(0.003)	(0.004)	(0.004)
3rd term FT - 1st term FT	0.026***	-0.003	0.024***	-0.003
	(0.007)	(0.004)	(0.007)	(0.005)
N observations	*276,018*			
N mothers	*72,168*			

Note: The sample includes mothers with at least one child 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 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 mothers' labour market outcomes of their youngest child's eligibility for free childcare by policy period

	(1) Main effect	(2) Interaction with (2000-2003) indicator	(3) Interaction with (2006-2009) indicator	(4) Interaction with (2010-2013) indicator
A. Labour force participation				
1st term PT eligibility	0.002	-0.003	0.001	0.002
	(0.008)	(0.009)	(0.008)	(0.008)
2nd term PT eligibility	0.004	0.003	0.007	0.009
	(0.009)	(0.008)	(0.008)	(0.009)
3rd term PT eligibility	0.011	0.006	0.006	0.019**
	(0.012)	(0.009)	(0.009)	(0.008)
4th term PT eligibility	0.025*	0.007	-0.004	-0.002
	(0.014)	(0.010)	(0.010)	(0.012)
5th term PT eligibility	0.036**	-0.020	-0.010	-0.019
	(0.017)	(0.015)	(0.013)	(0.015)
B. In work				
1st term PT eligibility	-0.004	-0.006	-0.001	0.002
	(0.007)	(0.008)	(0.008)	(0.007)
2nd term PT eligibility	-0.004	0.001	-0.004	0.013*
	(0.009)	(0.008)	(0.008)	(0.008)
3rd term PT eligibility	-0.002	0.002	0.004	0.020**
	(0.010)	(0.008)	(0.007)	(0.008)
4th term PT eligibility	0.009	0.005	0.003	0.009
	(0.011)	(0.009)	(0.010)	(0.009)
5th term PT eligibility	0.026*	-0.027**	-0.01	-0.023*
	(0.014)	(0.012)	(0.010)	(0.012)
Number of observations		*276,018*		

Note: The sample includes mothers with at least one child 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 and interact them with a dummy for being the youngest and with dummies for the year of observation being pre-2004, between 2006 and 2009, and being after 2010. All coefficients reported in this table pertain to the youngest child. 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 to sixth term of full-time childcare. The reported effect of eligibility to free part-time education is derived using interactions of term-of-eligibility with policy period dummies. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table 7 - Specification checks: effect on mothers' labour market outcomes of their youngest child's eligibility for free childcare

	(1) No mother FE		(2) With cubics in age for all children		(3) With age in months dummies for 2nd youngest child		(4) With age in months dummies for 2nd and 3rd youngest child	
	In labour force	In work	In labour force	In work	In labour force	In work	In labour force	In work
Part-time eligibility								
1st term	-0.003	-0.014	0.003	-0.004	0.003	-0.004	0.003	-0.004
	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
2nd term	-0.007	-0.024*	0.011	0.000	0.011	0.000	0.010	-0.001
	(0.013)	(0.014)	(0.008)	(0.006)	(0.008)	(0.006)	(0.008)	(0.006)
3rd term	-0.012	-0.027	0.021**	0.008	0.022**	0.008	0.022**	0.008
	(0.018)	(0.018)	(0.011)	(0.008)	(0.010)	(0.008)	(0.011)	(0.008)
4th term	-0.019	-0.029	0.023**	0.015	0.024**	0.015	0.023**	0.015
	(0.020)	(0.021)	(0.011)	(0.009)	(0.011)	(0.009)	(0.012)	(0.010)
5th term	-0.034	-0.043*	0.025*	0.014	0.025**	0.014	0.025*	0.014
	(0.023)	(0.024)	(0.013)	(0.011)	(0.013)	(0.011)	(0.013)	(0.011)
Full-time eligibility relative to 3rd term of part-time eligibility								
1st term	0.019*	0.004	0.031***	0.011*	0.031***	0.011*	0.031***	0.011*
	(0.011)	(0.011)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
2nd term	0.038***	0.016	0.053***	0.026***	0.053***	0.026***	0.053***	0.026***
	(0.012)	(0.013)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
3rd term	0.034***	0.015	0.057***	0.035***	0.057***	0.035***	0.057***	0.035***
	(0.013)	(0.015)	(0.011)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)
Number of observations	*292,590*		*276,018*					

Note: See notes to Table 5 for details on specfication. Results in column (1) 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 (2) 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 (3) use age bands and control for the age of the two youngest children using age in months dummies. Results in column (4) add age in months dummies for the second and third youngest child. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Table 8 - Robustness checks - effect on mothers' labour market outcomes of their youngest child's eligibility for free childcare

	(1)	(2)	(3)	(4)	(5)
	Allowing for term of birth specific coefficients				Controlling for funded places
	Spring borns	Summer borns	Autumn borns	*p-value*	(all terms of birth pooled)
A - Labour force participation					
1st term PT eligibility	0.007	0.004	0.000	*0.585*	0.003
	(0.006)	(0.006)	(0.006)		(0.005)
2nd term PT eligibility	0.016*	0.011	0.009	*0.6302*	0.009
	(0.009)	(0.009)	(0.009)		(0.008)
3rd term PT eligibility	0.030***	0.020*	0.021*	*0.3596*	0.020*
	(0.011)	(0.011)	(0.011)		(0.011)
4th term PT eligibility	0.027**		0.022*	*0.5309*	0.023**
	(0.012)		(0.012)		(0.011)
5th term PT eligibility			0.024*		0.025**
			(0.013)		(0.013)
Joint test of equality across all terms of eligibility				*0.8786*	
B - In work					
1st term PT eligibility	0.001	-0.008	-0.001	*0.1392*	-0.004
	(0.006)	(0.005)	(0.005)		(0.004)
2nd term PT eligibility	0.004	-0.006	0.002	*0.2598*	-0.001
	(0.007)	(0.008)	(0.007)		(0.006)
3rd term PT eligibility	0.012	0.004	0.008	*0.5683*	0.007
	(0.010)	(0.009)	(0.009)		(0.008)
4th term PT eligibility	0.020**		0.011	*0.1247*	0.015
	(0.010)		(0.010)		(0.010)
5th term PT eligibility			0.012		0.014
			(0.011)		(0.011)
Joint test of equality across all terms of eligibility				*0.4065*	
Number of observatins		276,018			271,339

Note: See notes to Table 5 for details on specfication. In the specification reported in columns (1) to (3), we also interact the eligibility dummies pertaining to the youngest child with dummies for his/her term of birth. In column (4), we report the p-value of a test of equality across the coefficients reported in the first three columns. Results in column (5) are for a specification similar to that in Table 5, where we also control for the proportion of 3 year olds in the LA of residence that have a funded part-time nursery place. All the coefficients reported in this table pertain to the youngest child only. Standard errors are clustered at the LEA level. *p<0.10, **p<0.05, ***p<0.01.

Appendix Tables

Appendix 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	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	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	1.142	4.656	6.642	11.273	22.739	23.587
	(0.079)	(0.158)	(0.185)	(0.216)	(0.340)	(0.288)
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. 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.

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

	(1)	(2)	(3)	(4)	(5)	(6)
	Subsidisable care		Any care		Informal care	
	Any use	Weekly	Any use	Weekly	Any use	Weekly
Part-time eligibility						
1st term	0.0809**	1.643*	-0.0473	-2.203	-0.155***	-3.419***
	(0.0334)	(0.851)	(0.0319)	(1.447)	(0.0411)	(1.064)
2nd term	0.0651	0.527	-0.0713*	-3.375*	-0.176***	-3.314**
	(0.0455)	(1.291)	(0.0427)	(2.040)	(0.0553)	(1.407)
3rd term	0.117**	1.146	-0.0761	-2.679	-0.183**	-3.784**
	(0.051)	(1.608)	(0.0498)	(2.544)	(0.0752)	(1.897)
4th term	0.177***	2.141	-0.0579	0.289	-0.127	-0.591
	(0.0631)	(2.169)	(0.0655)	(3.058)	(0.0881)	(2.104)
5th term	0.163**	1.940	-0.0697	-0.191	-0.139	-0.895
	(0.0726)	(2.539)	(0.0688)	(3.643)	(0.0994)	(2.490)
Average effect	0.108**	1.345	-0.0644	-2.06	-0.162***	-2.847*
	(0.0439)	(1.328)	(0.0428)	(2.059)	(0.0592)	(1.478)
Full-time eligibility relative to 3rd term of part-time eligibility						
1st term	0.0814**	1.867	0.0142	1.908	0.0034	1.356
	(0.0356)	(1.499)	(0.0329)	(1.948)	(0.0474)	(1.049)
2nd term	0.0923**	2.770	0.0428	3.648	0.0537	2.092
	(0.0416)	(1.690)	(0.0394)	(2.286)	(0.0585)	(1.304)
3rd term	0.11**	3.713**	0.0244	4.796*	0.0137	2.21
	(0.0446)	(1.759)	(0.0401)	(2.531)	(0.0640)	(1.431)
Average effect	0.0956**	2.839*	0.0257	3.513	0.0205	1.888
	(0.0393)	(1.593)	(0.0359)	(2.166)	(0.0532)	(1.171)
N observations				*11,187*		

Note: The sample is children aged 2 to 5.5 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, child's month of birth 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.

Appendix Table A3 - Effect on mothers' labour market outcomes of their youngest child's eligibility for free childcare by policy period, with additional controls

	(1) Main effect	(2) Interaction with (2000-2003) indicator	(3) Interaction with (2006-2009) indicator	(4) Interaction with (2010-2013) indicator
A. Labour force participation				
1st term PT eligibility	0.002	-0.004	0.001	0.002
	(0.008)	(0.009)	(0.008)	(0.008)
2nd term PT eligibility	0.003	0.003	0.006	0.01
	(0.010)	(0.008)	(0.009)	(0.009)
3rd term PT eligibility	0.008	0.008	0.008	0.021**
	(0.012)	(0.009)	(0.009)	(0.008)
4th term PT eligibility	0.025*	0.006	-0.004	-0.001
	(0.014)	(0.011)	(0.011)	(0.012)
5th term PT eligibility	0.036**	-0.020	-0.011	-0.018
	(0.017)	(0.015)	(0.013)	(0.015)
B. In work				
1st term PT eligibility	-0.003	-0.007	-0.002	0.002
	(0.007)	(0.008)	(0.008)	(0.007)
2nd term PT eligibility	-0.004	0.000	-0.004	0.013
	(0.009)	(0.008)	(0.008)	(0.008)
3rd term PT eligibility	-0.003	0.004	0.0054	0.021**
	(0.010)	(0.008)	(0.008)	(0.008)
4th term PT eligibility	0.009	0.005	0.004	0.009
	(0.011)	(0.009)	(0.010)	(0.009)
5th term PT eligibility	0.027*	-0.029**	-0.011	-0.023*
	(0.014)	(0.012)	(0.010)	(0.012)
Number of observations		*271,315*		

Note: See notes to Table 7 for details on this specification. The only difference with the specification in Table 7 is that here we also control for the contemporaneous local unemployment rate, the proportion of 3-year-olds for whom a funded place is available in the local authority of residence of the mother in each year and a dummy that is set to 1 beginning 12 months before the estimated loss of entitlement to the unconditional welfare benefit

Appendix Table A4 - Effect on mothers' labour market outcomes of their child's eligibility for free full-time childcare vs. alternative counterfactuals

	(1)	(2)	(3)	(4)
	In labour force		In work	
	Youngest child	Non-youngest child	Youngest child	Non-youngest child
A - Impact of full-time eligibility relative to nothing				
1st term FT	0.052***	0.000	0.019*	0.004
	(0.011)	(0.005)	(0.010)	(0.005)
2nd term FT	0.074***	0.003	0.033***	0.004
	(0.013)	(0.004)	(0.011)	(0.004)
3rd term FT	0.078***	-0.002	0.042***	0.000
	(0.014)	(0.004)	(0.013)	(0.003)
B - Impact of full-time (FT) eligibility relative to 4th term of part-time (PT) eligibility				
1st term FT - 4th term PT	0.029***	-0.006	0.004	-0.002
	(0.006)	(0.006)	(0.005)	(0.006)
2nd term FT - 4th term PT	0.051***	-0.003	0.019***	-0.002
	(0.007)	(0.007)	(0.008)	(0.007)
3rd term FT - 4th term PT	0.055***	-0.009	0.028***	-0.006
	(0.010)	(0.008)	(0.010)	(0.007)
C - Impact of full-time (FT) eligibility relative to 5th term of part-time (PT) eligibility				
1st term FT - 5th term PT	0.027***	0.001	0.005	-0.008
	(0.006)	(0.006)	(0.005)	(0.006)
2nd term FT - 5th term PT	0.049***	0.003	0.02***	0.007
	(0.008)	(0.008)	(0.006)	(0.008)
3rd term FT - 5th term PT	0.053***	-0.002	0.029***	-0.011
	(0.011)	(0.008)	(0.009)	(0.008)
Number of observations	*276,018*			
Number of mothers	*72,168*			

Note: See note to Table 5 for details on the specification underlying these coefficients.

Appendix Table A5 - Heterogeneity analysis: Effect on mothers' labour market outcomes of their youngest child's eligibility for free part-time and full-time childcare

	(1) Partnership status		(2) Education		(3) Local unemployment	
	main effect	* mother has partner	main effect	* low education	main effect	* low unemp in TTWA
A. Labour force participation						
1st term PT	0.000	0.003	-0.007	0.023**	0.002	0.004
	(0.009)	(0.010)	(0.005)	(0.010)	(0.006)	(0.009)
2nd term PT	0.016	-0.007	0.002	0.017	0.011	-0.001
	(0.014)	(0.013)	(0.009)	(0.015)	(0.010)	(0.016)
3rd term PT	0.033**	-0.016	0.017	0.01	0.016	0.012
	(0.016)	(0.014)	(0.012)	(0.020)	(0.013)	(0.020)
4th term PT	0.036**	-0.018	0.016	0.015	0.014	0.021
	(0.018)	(0.017)	(0.014)	(0.024)	(0.015)	(0.022)
5th term PT	0.031	-0.009	0.021	0.009	0.016	0.022
	(0.021)	(0.020)	(0.017)	(0.027)	(0.017)	(0.026)
1st term FT - 3rd term PT	0.035***	-0.005	0.035***	-0.008	0.028***	0.008
	(0.011)	(0.011)	(0.010)	(0.012)	(0.007)	(0.012)
2nd term FT - 3rd term PT	0.058***	-0.008	0.060***	-0.013	0.041***	0.031**
	(0.015)	(0.015)	(0.013)	(0.016)	(0.009)	(0.015)
3rd term FT - 3rd term PT	0.065***	-0.011	0.071***	-0.025	0.043***	0.037*
	(0.017)	(0.016)	(0.016)	(0.020)	(0.011)	(0.019)
B - In work						
1st term PT	-0.009	0.006	-0.008	0.009	-0.001	-0.005
	(0.007)	(0.008)	(0.005)	(0.008)	(0.005)	(0.008)
2nd term PT	0.007	-0.010	0.000	0.000	0.003	-0.009
	(0.010)	(0.011)	(0.009)	(0.013)	(0.009)	(0.013)
3rd term PT	0.022*	-0.019	0.015	-0.013	0.013	-0.013
	(0.012)	(0.012)	(0.012)	(0.018)	(0.011)	(0.015)
4th term PT	0.028**	-0.018	0.02	-0.01	0.015	-0.001
	(0.014)	(0.015)	(0.014)	(0.022)	(0.013)	(0.017)
5th term PT	0.026	-0.016	0.016	-0.004	0.011	0.007
	(0.016)	(0.016)	(0.017)	(0.024)	(0.014)	(0.020)
1st term FT - 3rd term PT	0.007	0.005	0.015*	-0.008	0.002	0.025**
	(0.009)	(0.009)	(0.009)	(0.012)	(0.006)	(0.011)
2nd term FT - 3rd term PT	0.014	0.015	0.036***	-0.019	0.01	0.043***
	(0.012)	(0.011)	(0.012)	(0.016)	(0.009)	(0.015)
3rd term FT - 3rd term PT	0.029*	0.008	0.049***	-0.026	0.020*	0.040**
	(0.015)	(0.013)	(0.016)	(0.019)	(0.011)	(0.018)
Number of observations	276,018		275,703		275,994	

Note: The sample includes mothers with at least one child 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 and interact them with a dummy for being the youngest child and a subgroup dummy (dummy for having a partner; dummy for low education; and dummy for living in a low unemployment area). 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. The regressions also control for the number of children in the age bands 0-2; 2-4; 5-9; 10-15 in the household, an interaction between these variables and the subgroup dummy, age-in-month dummies of the youngest child in the household, interactions between all of these dummies and the subgroup dummy, quarter of observation dummies, whether the mother has a partner (in columns 2 and 3) and whether the child is eligible for 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 A6 - Effect on mothers's other labour market outcomes of their youngest child's eligibility to free childcare

	(1) Working hours	(2) >0 & <16 hrs	(3) >=16 & <30 hrs	(4) 30+ hrs	(5) Looking for work	(6) In education	(7) Self-employment
Part-time eligibility							
1st term	-0.057	-0.004	-0.004	0.004	0.003	0.001	0.001
	(0.123)	(0.004)	(0.006)	(0.004)	(0.004)	(0.002)	(0.002)
2nd term	-0.024	0.003	-0.01	0.007	0.006	-0.001	-0.002
	(0.193)	(0.006)	(0.008)	(0.006)	(0.006)	(0.003)	(0.003)
3rd term	0.035	0.010	-0.010	0.009	0.010	-0.001	-0.001
	(0.273)	(0.008)	(0.010)	(0.008)	(0.008)	(0.004)	(0.004)
4th term	0.297	0.016*	-0.017	0.019**	0.006	0.003	0.002
	(0.318)	(0.009)	(0.013)	(0.009)	(0.009)	(0.005)	(0.004)
5th term	0.344	0.013	-0.018	0.022**	0.012	0.003	-0.002
	(0.373)	(0.011)	(0.014)	(0.011)	(0.011)	(0.005)	(0.005)
Average effect	0.061	0.006	-0.01	0.01***	0.007	0.001	-0.001
	(0.105)	(0.006)	(0.009)	(0.003)	(0.010)	(0.001)	(0.003)
Full-time eligibility relative to 3rd term of PT eligibility							
1st term	0.318	0.008	-0.005	0.009	0.014***	0.004	0.000
	(0.194)	(0.006)	(0.007)	(0.006)	(0.005)	(0.003)	(0.003)
2nd term	0.600**	0.011	0.003	0.013*	0.014***	0.006	0.000
	(0.273)	(0.008)	(0.009)	(0.007)	(0.006)	(0.004)	(0.004)
3rd term	0.838***	0.012	0.003	0.020**	0.005	0.006	0.001
	(0.337)	(0.009)	(0.012)	(0.009)	(0.007)	(0.005)	(0.004)
Average effect	0.600**	0.0100*	0.000	0.015***	0.011*	0.006***	0.000
	(0.264)	(0.006)	(0.005)	(0.003)	(0.006)	(0.001)	(0.003)
Dynamic effects							
2nd term FT - 1st term FT	0.282***	0.002	0.008	0.004	-0.001	0.002	0.000
	(0.115)	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.002)
3rd term FT - 2nd term FT	0.238**	0.002	0.000	0.006**	-0.008***	0.000	0.001
	(0.117)	(0.004)	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)
3rd term FT - 1st term FT	0.520***	0.004	0.008	0.010	-0.009*	0.002	0.001
	(0.198)	(0.006)	(0.008)	(0.006)	(0.005)	(0.003)	(0.003)
Number of observations	*273,920*	*273,920*	*273,920*	*273,920*	*276,018*	*276,018*	*276,018*

Note: See notes to Table 5 for details on these specifications