

# Female employment and pre-kindergarten: on the unintended effects of an Italian reform\*

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## Abstract

We build a model in which mothers need to buy childcare services not only if they work but also if they search for a job; we show that a reduction in the childcare price will increase their likelihood of searching but may decrease their willingness to accept a job offer. We test model's implications through a Regression Discontinuity and a Difference in Discontinuities design. In Italy, the introduction of pre-kindergarten - a cheaper alternative to daycare for 2-year-old children - increased both participation in the labour market and employment of mothers of eligible children. The latter effect was driven largely by a decrease in the reservation wage.

**Keywords:** Childcare, Female Labour Supply, Public Services

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# 1 Introduction

Affordable childcare services are praised by the most recent economic literature as a powerful tool for developing children’s human capital (Cunha and Heckman, 2007). Moreover, there exists a strong positive cross-country correlation between the availability of childcare services and the female labour market participation rate on the one hand, and the fertility rate on the other hand (OECD, 2011). On these grounds, both developed and developing countries have progressively adopted policies aimed at improving the availability and affordability of childcare services. Some of these policies consist in providing public financial support to families for their childcare expenses in the form of either vouchers or tax credits; others, instead, entail the direct provision of services.

In this paper we investigate the effects on mothers’ labour supply decisions of a policy that consisted in sharply reducing the price of childcare. We call these effects ‘unintended’ because the policy we analyse was originally introduced neither with the aim of helping mothers to reconcile work and family responsibilities, nor with that of fostering early childhood development. Our paper couples a theoretical model with a reduced form empirical analysis. The combination of these two approaches allows us to shed light on the mechanisms that underlie the observed policy responses.

We build a job search model in line with (Pissarides, 2000). Employed mothers pay the full price  $p$  of childcare, as standard. Differently from the existing literature and based on the evidence that women bearing childcare responsibilities search for a job less intensively than men (Krueger and Mueller, 2012), we explicitly consider that mothers that search for a job need to buy childcare as well. In particular, searching mothers pay a fraction  $s$  of the full price, reflecting a lower family income - which usually determines the fees - or the fact that they might need to buy childcare services only on a part-time basis. In the model a reduction of  $p$  boosts female labour market participation, but has ambiguous effects on the reservation wage and employment. In fact, while cheaper childcare clearly increases the returns from working, as a side effect it also increases the value of being unemployed, by reducing the cost of searching for a job. We show that when  $s$  is high enough, the second effect prevails and a reduction of  $p$  increases the reservation wage.

We take advantage of an Italian school reform to test our theoretical predictions. Before the reform, access to kindergarten in September was granted to 2-year-old children born by 31 December. The reform extended the access to those born between 31 December and 30 April, thereby providing families with a much cheaper alternative to daycare.

For the sake of expositional convenience, we refer to this early access to kindergarten as *pre-kindergarten* (PK). We exploit the discontinuous rule of PK-eligibility and run a *Sharp Regression Discontinuity* to identify the causal effect of the reform. According to our results, which have been also validated through a *Difference in Discontinuities* analysis, the reform increased the maternal labour market participation and the probability of being employed by 6 and 5 percentage points, respectively. The monthly reservation wage declined by 120 euros, (at least partly) driving the increase of the employment.

We contribute to the existing literature in several ways. On the theoretical front, we are the first to model the relationship between the price of childcare and maternal labour supply in a job search framework. This allows us to focus on the extensive margin, which has been shown to be more responsive than the intensive one (Blundell et al., 2013). Previous theoretical contributions (Heckman, 1974; Blau and Robins, 1988) develop frictionless and static models in which childcare is used only when the mother works. In this setting, a reduction in its price unambiguously increases maternal net wages, participation and employment. The effect on working hours is ambiguous and, not surprisingly, is the main focus of these contributions. Differently from standard job search models, we consider that childcare is also needed by mothers who search for a job.

From the point of view of the empirical literature, our paper innovates on three dimensions. First, the richness of our dataset allows us to estimate the effect of a reduction in the price of childcare on (i) reservation wage, (ii) participation and (iii) employment, separately. To our knowledge, the estimate on the reservation wage has never been provided before. Secondly, despite the growing literature on childcare services and female labour supply (see Table 1), the Italian context has only been little analysed, mainly due to data limitations. Chiuri (2000) shows that childcare rationing and the availability of informal care arrangements significantly depress maternal labour supply. Del Boca and Vuri (2007) focuses on the availability of childcare services; Brilli et al. (2014) structurally estimates the effects of public childcare availability on both mothers' working status and children's test scores. With respect to these papers, we provide evidence on the effects of a change in childcare prices - rather than availability - and our identification strategy provides a cleaner estimate of the causal effect. Finally, we focus on children aged 2 to 3, while most of the previous works consider older children, with the only exception of Goux and Maurin (2010).

Our paper is also of first order policy relevance in the Italian context, where female

labour market participation and employment rates are particularly low.<sup>1</sup> Thus, identifying and assessing the importance of an obstacle to women’s participation in the labour market can be particularly useful for addressing future policy interventions. Moreover, the specific policy that we analyse presents several interesting features. On the one hand, it was a zero cost policy<sup>2</sup> because it did not require any extra allocation of resources to kindergartens but simply established a shift in the age profile of pupils. On the other hand, it could be particularly effective in helping women who had exited the labour market during pregnancy to re-enter it quickly, as it targeted mothers fairly soon after their exit. A delayed re-entry might be detrimental to women’s careers and job prospects, and this problem is becoming particularly serious in Italy, where the proportion of women who stay out of the labour market two years after the child’s birth is increasing over time: in 2012 it was 22.4%, whereas in 2000, it was just 18% (Istat, 2014).

The remainder of the paper is organized as follows: Section 2 introduces our theoretical framework; the Italian institutional context is then presented in Section 3; Section 4 provides a short description of the dataset and illustrates the main features of our sample; our empirical strategy is then explained and discussed in Section 5; Section 6 provides detailed information on the estimation procedures and in Section 7 we report the results of the empirical analysis; Section 8 provides some specification checks; Section 9 concludes.

## 2 Theoretical framework

That childcare responsibilities affect female labour supply has been widely documented by the economic literature over the last forty years. Early studies on this topic focused on the effects of childcare services on the *intensive* margin of labour supply (Heckman, 1974; Blau and Robins, 1988). In these studies, childcare is paid for each working hour and reduces the mother’s net hourly wage. Under this assumption, a childcare price reduction increases the net hourly wage, with an ex-ante ambiguous impact on working hours, due to the interaction between a positive substitution and a negative income effect. Indeed, the empirical literature found that the elasticity of maternal working hours to the net wage rate has a negligible magnitude, i.e. female labour supply responds little in terms of hours of work, while estimates of the effects on the extensive margin tend to be positive and of considerable magnitude (Blundell et al., 2013). We therefore decide to focus on

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<sup>1</sup>In 2012 the participation rate of Italian women aged 15-64 was 53.5%, against the EU15 average of 67%. The employment rate was 46.1%, against the EU15 average of 59.4%.

<sup>2</sup>We recognize that in the transition period the policy could have entailed additional costs due to the higher influx of children in the school system; however, we believe they have been negligible with respect to alternative policy interventions.

the extensive margin and model the relationship between the price of childcare services and female labour supply in a dynamic setting, employing the tools of job search models (Pissarides, 2000).

Unlike the standard models in which the cost of childcare is only borne if the mother works because otherwise she can take care of the child full time, we allow for the possibility that mothers need to buy childcare services when they search for a job as well. Indeed, job search models assume that search intensity is an important input of the matching function, so that workers who devote more time (Holzer, 1987) and effort (Shimer, 2004) to their search find a job more quickly. Recent studies based on time use surveys (Krueger and Mueller, 2012; Aguiar et al., 2013) have shown that women devote consistently less time to job search activities than men, the difference being especially large in countries in which female participation in the labour market is particularly low (e.g. Italy and Spain). Moreover, the existing estimates suggest that there is a significant negative relationship between job search intensity and family care duties, as married women and those with young or several children appear to search less actively (Krueger and Mueller, 2012; Di Addario, 2011).

In the light of these findings, we believe that to describe accurately the effect of reducing the price of childcare on women's labour market outcomes, one needs to build a model in which childcare services are needed not only by women who have a job but also by those who are actively searching for one. Assuming that formal childcare services can be used by women only when they find a job is therefore not only unrealistic, because the enrolment decision can only be limited to a specific time period of the school year, but also in contrast with the most recent literature on job search intensity.

Our model allows for the possibility that the price paid for childcare by unemployed women is lower than that paid by employed women. This reflects the fact that kindergartens typically charge fees based on family income, so that a single-earner family would generally pay less. Alternatively, it may also proxy for the fact that women job seekers can devote more time to looking after the child themselves than working women so that, for example, they may only need to use part-time childcare services and so pay less for them.

In what follows we introduce the model formally, describing the general set-up first and then deriving implications about the effect of lowering the cost of childcare on the mother's decision to search for a job (labour market participation) and to accept a job

offer (employment).

## 2.1 The basic set-up

We consider a population of mothers whose youngest child is aged 0-2. The mother is the only individual responsible for the care of the child. The timing of events is as follows. At time  $t = 0$  the school year starts and the mother decides whether or not to enrol her child in formal childcare. Childcare services can be bought in the market only at the beginning of the school year. If she does not enrol her child, the mother remains out of the labour market, whereas if she wants to find a job she needs to buy childcare services. Therefore she incurs the cost of childcare before knowing whether she will get a job or not.<sup>3</sup> Conditional on enrolment, a mother may receive in any period  $t$  a job offer. If she accepts, she will be employed and never quit the job; in the case of rejection she remains unemployed and keeps searching for a job. At time  $t = T$  labour market status is observed;<sup>4</sup> a mother can be (i) non-participant; (ii) job searcher (or unemployed); or (iii) employed.

The problem of the mother is the following. First, she chooses to participate or not given her expected job opportunities and the cost of childcare; second, conditional on participation, when a job offer arrives she decides whether to accept it or not. We assume that before time  $T$  no structural change occurs in the labour market and all relevant decisions - the participation status and the job-offer accepting rule - are taken at  $t = 0$ .

The mother maximizes her life-time utility:

$$\sum_{t=0}^{\infty} (1-r)^t u(c_t) \tag{1}$$

where  $0 \leq r < 1$  is the discount rate and  $c_t$  is current consumption, which varies depending on her labour market status. The instantaneous utility from consumption  $u(c_t)$  is assumed to be increasing and concave.

The value function of a mother choosing to stay out of the labour force (non-participant)

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<sup>3</sup>The type of care we are considering is formal childcare and we assume that free childcare is not available. An extension of the model consists in distinguishing between formal childcare, accessible only at the beginning of the school year and before the job search outcome is known, and informal childcare, needed only in case of employment. In this simplified version we assume the mother prefers formal care, even if she faces the risk of not finding a job, to informal care.

<sup>4</sup>In the empirical part this will be three quarters of the school year.

is:

$$rV_o = u(\delta_o) \quad (2)$$

where  $\delta_o$  is the stream of real returns from non-participation, which can be thought of as the value of home production. Moreover, a non-participating mother directly provides care for the child and no external care is needed.

Active mothers buy childcare services at a market price  $p$ . However, only a fraction  $s < 1$  of the full price  $p$  is paid by unemployed mothers as they might have access to discounts or lower tariffs or use only part-time childcare services. Moreover, we assume that job seeker mothers still carry out home production  $\delta_o$ .

A mother that looks for a job receives a job offer, which is fully described by a wage  $w$  drawn from a cumulative distribution  $F(w)$ , with probability  $\lambda$ . If the offer is accepted, the mother becomes employed, otherwise she continues to look for a job. We rule out the possibility of recalling a job offer. The continuation utility  $rV_s$  from looking for a job is the sum of the utility from the flow of real returns in the case of job seeking,  $u(\delta_o - sp)$ , and the expected value from moving into employment at a future date  $t$ :

$$rV_s = u(\delta_o - sp) + \lambda \max \left[ \int_w V_e(x) dF(x) - V_s; 0 \right]. \quad (3)$$

When employed, the mother inelastically supplies one unit of labour at wage  $w$  and has to buy childcare services at price  $p$ .<sup>5</sup> We rule out the possibility of layoffs and on-the-job search. The value function of being employed is:

$$rV_e = u(w - p). \quad (4)$$

where  $w - p > \delta_o > \delta_o - sp$ , otherwise there is no incentive for the mother to participate.

## 2.2 The participation decision

At time  $t = 0$  the mother decides whether to participate in the labour market or not. The mother has no reason to revise her first decision afterwards and switch from participation to non-participation, or vice versa. At  $t = 0$  the maximum of the value function of being non-participant is:

$$V_o = \max [V_s; u(\delta_o) + (1 - r)V_o]. \quad (5)$$

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<sup>5</sup>The main assumption is that free childcare is not available; this is quite realistic given geographical mobility and pension reforms: parents live away from grandparents and they cannot rely on their help.

The condition for participation simply requires  $V_s \geq u(\delta_o)/r$  and, if at  $t = 0$  it is optimal to look for a job, it will be so in the following periods. To inspect the participation condition it is necessary to solve for  $V_s$ .

Combining equations (3) and (4) yields:

$$V_s = \frac{u(\delta_o - sp) + \frac{\lambda}{r} \int_w u(x - p) dF(x)}{r + \lambda} = \frac{u_s + \frac{\lambda}{r} \mathbb{E}(u_e)}{r + \lambda} \quad (6)$$

where  $u_s = u(\delta_o - sp)$  is the per-period utility of consumption if unemployed and  $\mathbb{E}(u_e) = \int_w u(x - p)$  is the expected utility of consumption in the case of employment. A mother participates if  $V_s \geq V_o$ . It is straightforward to derive our first set of results.

**Proposition 1** *A reduction in the price of childcare increases maternal participation as:*

$$\frac{\partial V_s}{\partial p} = -\frac{su'_s + \frac{\lambda}{r} \mathbb{E}(u'_e)}{r + \lambda} < 0. \quad (7)$$

Participating in the labour market is like a lottery: the mother pays the cost  $sp$  for participation in order to increase her consumption possibilities from  $\delta_o$  to  $w - p$ . The lower the price  $p$ , the more participation is worthwhile: the ‘‘participation fee’’ of the lottery is lower and the net expected benefit is higher, creating incentives to exit from non-participation status.

**Proposition 2** *When the probability of receiving a job offer is higher,<sup>6</sup> the effect of a reduction of  $p$  on maternal participation might be larger or smaller. It is larger only for sufficiently low values of  $s$ , the fraction of the full price of childcare paid in the case of unemployment:*

$$\frac{\partial^2 V_s}{\partial p \partial \lambda} = -\frac{\mathbb{E}(u'_e) - su'_s}{(r + \lambda)^2} = \begin{cases} \leq 0 & \text{if } s \leq \frac{\mathbb{E}(u'_e)}{u'_s} \\ > 0 & \text{if } s > \frac{\mathbb{E}(u'_e)}{u'_s}. \end{cases}$$

The lower price of childcare increases the mother’s utility both when she is unemployed, by  $su'_s$ , and when she has a job, by  $\mathbb{E}(u'_e)$ . If the utility gain is higher when the mother works, women living in areas with a higher probability of finding a job will participate more than those living in areas with a lower probability. Since  $\mathbb{E}(u'_e) < u'_s$  by definition, for the utility gain associated with the lower childcare price to be higher in the case of employment, the cost of childcare when unemployed has to be ‘sufficiently low’, as

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<sup>6</sup>We are interpreting  $\lambda$  independent of individual characteristics and determined by demand-side variables.



expressed in Proposition 2.

Finally, if wages are a non-decreasing function of marginal productivities or education levels (Becker, 1964; Mortensen, 1978; Mincer, 1994), the following result can be established:

**Proposition 3** *The effect of reducing  $p$  on participation is larger for less educated mothers.*

Indeed, equation (7) is increasing, in absolute value, in the expected marginal benefit from employment,  $\mathbb{E}(u'_e)$ .

This result is driven by the concavity of the function  $u$  and by the assumption that less educated women face lower expected wages, which reflects their corresponding productivity. The higher the expected wage, the smaller is the benefit of a reduction of  $p$  in terms of utility.

### 2.3 The employment decision

A reduction of the fixed cost of participation, i.e. of childcare, not only makes participation less costly, but also affects the decision rule related to accepting a job offer or not. The decision rule is based on the definition of a reservation wage,  $R$ , the wage at which the agent is indifferent between accepting the offer or continuing to search and waiting for another offer:

$$\frac{u(R - p)}{r} = V_s. \quad (8)$$

Replacing (8) in equation (3) and after some manipulations, we get the following optimality condition:

$$u(R - p) - u(\delta_o - sp) = \frac{\lambda}{r} \int_{w \geq R} [u(x - p) - u(R - p)] dF(x). \quad (9)$$

On the right-hand side there is the discounted expected benefit of another period of search. On the left-hand side there is the opportunity cost, in the form of forgone earnings, of searching for another period. As the first is increasing in  $R$  while the second is decreasing, the existence of a unique solution of (9) is guaranteed.

The price of childcare affects both the cost and the benefit of searching, thus the reservation wage:

$$\frac{\partial R}{\partial p} = \frac{u'(R - p) - su'(\delta_o - sp) - \frac{\lambda}{r} \int_{w \geq R} [u'(x - p) - u'(R - p)] dF(x)}{u'(R - p) \left[1 + \frac{\lambda}{r} (1 - F(R))\right]}. \quad (10)$$

Indeed, lowering the price of childcare has an unambiguously negative effect on the

discounted expected benefit of searching for another period, as the incentive to wait for a better offer is lower. The result is driven by the concavity of the utility function and reduces the reservation wage (the last term in equation (10); see Figure 1). On the other hand, the effect on the opportunity cost of search for another period is ambiguous, and depends on the relative gain in terms of utility associated with a lower price of childcare in the case of employment and unemployment. If the price reduction benefits more the employed mother, the cost of waiting for a better offer will be higher and this will induce the mother to accept a lower wage offer, reducing her reservation wage (the difference term in (10) is positive). If, instead, the price reduction benefits more the unemployed mother, then the opportunity cost of searching for another period will be lower and the reservation wage might increase (the difference term in (10) is negative). More in detail, if the discounted price reduction in case of unemployment and further job search is, in terms of marginal utility, greater than the discounted price reduction in case of employment at  $R$ , then the unemployed mother thus becomes more choosy in evaluating job offers after the childcare price reduction (the reservation wage increases). Again, it depends on the generosity of the welfare benefit in terms of childcare fee discounts for jobless mothers, as expressed in the following Proposition.

**Proposition 4** *Let the probability of being employed be  $h = \lambda F(R)$ , which is the probability of receiving an offer higher than the reservation wage. It might be decreasing or increasing in the price of childcare:*

$$\frac{\partial h}{\partial p} = -\lambda f(R) \frac{\partial R}{\partial p} = \begin{cases} \leq 0 & \text{if } s \leq \bar{s} \\ > 0 & \text{if } s > \bar{s}, \end{cases}$$

where  $\bar{s}$  is:

$$\bar{s} = \frac{u'_e(R) \left(1 + \frac{\lambda}{r}\right) - \frac{\lambda}{r} \mathbb{E}_{w \geq R}(u'_e)}{u'_s}.$$

In the next sections we move to the empirical analysis, through which we aim to verify our predictions on participation and to shed light on the behavioural effect of a childcare price reduction on the employment decision.

### 3 Institutional setting

Early access to kindergarten was regulated, for the first time, in 2003 by Law 53/2003, known as the ‘‘Moratti Reform’’, after the Minister of Education of the time. Differently

from what happened in other countries, in Italy the introduction of pre-kindergarten was not driven by the idea of taking care of early childhood development, nor of encouraging female labour market participation. Instead, at least at the beginning, it was merely a consequence of the introduction of early access to primary school: in the attempt to reduce the age of high school completion from 19 to 18 years old so as to align the Italian school system to the other European ones, access to primary education was allowed for children who turned 6 by 30 April of the year after enrolment (enlarging the number of school eligible pupils). Early access to primary education, though, entailed the risk of emptying kindergartens so, to avoid this, the Ministry decided to apply the same anticipation rule to allow 2-year-old children to access kindergarten.<sup>7</sup> Kindergartens still had to give priority to regular students (3-year-old children), but no skills requirements were introduced.

Kindergartens, which are mostly public, cost significantly less than both public and private day care centres in Italy. According to [Istituto Degli Innocenti \(2011\)](#) the monthly rate for full-time service is, respectively, 394 euros in public day care centres, 487 euros in private facilities, and 130 euros in kindergartens. The monthly part-time rate is, in the same order, 296, 386 and 50 euros. In Italy there are no other notable alternatives to formal day care services such as registered child-minders, who take care of a small group of children in their own home, particularly common in the United Kingdom and France. Hence, in the absence of grandparents who can look after the children, families generally choose to employ a nanny. While we can imagine that this option was always available, there is no doubt that its cost was much higher than that of a nursery. Therefore the introduction of pre-kindergarten represented a reduction in the price of childcare in that it extended a low cost service to a population of families that had previously been excluded.

Single-earner families typically pay lower rates than two-earner families both for day care and for kindergarten. First, monthly rates are modulated according to a means test (ISEE, *Index of Equivalent Economic Situation*) based on family income. Second, discounts specifically addressed to single-earner families are also granted. Yet, the fee schedules are such that low income families pay approximately the same amount for day care and kindergarten, while high income families pay significantly more for day care. As a consequence, moving from day care to kindergarten implies a consistently larger discount for high income families than for low income ones (see [Table 2](#)).

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<sup>7</sup>Early access to kindergarten was regulated exactly like early access to school: it extended the possibility of enrolling to children who turned 3 by April of the school year, while previously children would be accepted into kindergarten if they turned 3 by December of the school year.

Pre-kindergarten was activated in the school year 2003/04 and ran for three years under the standard eligibility rule, by which children had to turn 3 by 30 April to be admitted to kindergarten (see Table 3 for a summary of the relevant changes in access rules). In this first phase pre-kindergarten was used quite extensively: in 2003/04 early students were 49 thousand, 9.1% of 2-year-olds, while in 2005/06 they were 71 thousand, around 13%. Among early students, most were located in the Southern regions and went to private kindergartens (Istituto Degli Innocenti, 2011).

The positive result registered prompted the legislator to think about the pedagogical and educational content of pre-kindergarten. As it did not feature any special programme for the very young, it was perceived as a way of forcing children's natural development pattern. For this reason the new government appointed in 2006 took a step back and established that children could be enrolled in kindergarten only if they turned 3 by 28 February of the school year. In this way the number of families that could benefit from access to the low cost service was considerably reduced with respect to the first phase of pre-kindergarten. This rule remained in place for two years: 2006/07 and 2007/08.

In the school year 2008/09, after another change of government, pre-kindergarten was abolished<sup>8</sup> and replaced by a new educational service for children aged 24 to 36 months, called "Sezioni Primavera". It was created within the nurseries and was open to all children who turned 2 by 31 December of the school year. Even if this new service was considered of better quality than pre-kindergarten, the number of children enrolled was considerably lower (about 25 thousand fewer children), partly because the service was only activated in scattered areas owing to its high costs.<sup>9</sup>

Pre-kindergarten was reintroduced in the school year 2009/10<sup>10</sup> in order to meet the demand for childcare that had emerged during the first years, while still providing a service of good quality. Indeed, it was established that kindergartens offering early access had to offer suitable places and equipment for 2-year-old children, while still giving priority access to older children. In this phase the eligibility rule was again set at 30 April as in the first years. Several things happened in this new phase of pre-kindergarten: (i) the number of children using the service increased: they numbered 83 thousand in 2010/11 (15% of 2-year-olds), 86 thousand in 2011/12 (15.1%). These figures imply that the share

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<sup>8</sup>Financial Law 297/2006; the last school year of application was 2007/08.

<sup>9</sup>While private schools managed to offer a number of places similar to that guaranteed by early access to kindergarten, public institutions activated only one quarter of the places available through early access to kindergarten. Therefore, this service did not represent a reduction in the cost of childcare.

<sup>10</sup>Decree of the President of the Republic 89/2009.

of eligible children who were actually enrolled to pre-kindergarten was over 40%. (ii) Public schools outnumbered private ones (differently from the first phase); in particular, there was a sharp decrease in the use of private schools in the South. (iii) There was a marked concentration of pre-kindergarten users in the South, which accounted for almost 50 thousand out of a national total of 86 thousand early students (58%); considering only public schools, this proportion rises to 67%. Looking at geographical heterogeneity within the country, we can see that in 2011/12 the take-up rate of pupils eligible for early access was inversely related to the availability of alternative childcare services,<sup>11</sup> as shown in Figure 2. The coverage rate provided by childcare services was between 14% and 17% in the North and in the Centre, while it ranged between 3.5% and 6% in the South. Inversely, the take-up rate by eligible children reached 60% in the Southern regions and remained below 30% in the Centre and in the North (Istituto Degli Innocenti, 2011).

## 4 Data and descriptive statistics

Our study relies on data drawn from the Italian labour force survey, which is a quarterly rolling panel dataset collected by Istat, the Italian statistical office. The dataset contains about 250,000 households, 600,000 individuals per wave, for whom detailed information about their labour market status, as well as their family structure and other socio-economic characteristics is collected.

We build a dataset that spans from the school year 2004/05 to the school year 2011/12 and select a sample of mothers aged 15 to 60, whose youngest child is 2-3 years old. We decide to focus on the youngest child in the family because that is the relevant margin for a mother who has to decide whether to participate in the labour market or not: if she has a younger child who still needs to be looked after, the fact that the older one can be enrolled in pre-kindergarten will not affect her labour market participation decision. Our dependent variables of interest are an indicator of labour market participation, which equals one if the mother either actively searched for a job in the previous four weeks<sup>12</sup> or was employed in at least one quarter during the school year, and an indicator of employment that equals one if she was employed in at least one quarter during the school year. We exclude from our analysis the summer quarter as kindergartens are generally closed in those months. We end up with about 10,500 women, whose main characteristics

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<sup>11</sup>This is measured by Istat as the number of children enrolled in daycare services over the reference population, and is referred to as “coverage rate”.

<sup>12</sup>We apply the ILO definition of unemployed.

are summarized in Table 4, in which the sample is split according to the child’s eligibility for pre-kindergarten.

The data confirm the widely known fact that Italian mothers are relatively old in comparison with mothers in continental Europe, and indeed the average age of mothers in our sample is above 34 years.<sup>13</sup> Second, the size of the households is small: on average there are fewer than four people in the household, which suggests not only that couples often have only one child, but also that it is rare for grandparents to live in the same household. Moreover, about 14% of women in our sample are single. In terms of education, it appears that almost one third of the women in the sample have at most reached compulsory school leaving level (age 14), 47% of them have a high school diploma, and about 20% have a college or higher education qualification. With respect to their labour market status, we observe that 59.7% are either searching for a job or are employed (labour market participants); of these about 90% are employed while the others are searching. We also report that the employed women in our sample work on average 26.4 hours per week, less than a full-time job, and earn slightly more than 1,000 euros per month. Moreover, starting from 2009, the labour force survey contains data on the reservation wage of all non-employed people: we learn that the unemployed mothers in our sample would not work for less than about 785 euros per month.

## 5 Identification

Identification of a causal relationship between the price of childcare and mothers’ labour supply choices potentially entails endogeneity issues in that mothers are likely to choose simultaneously the type and quality of childcare service to use and whether to supply labour. For example, having a well-paid job would allow mothers to afford more expensive childcare services. The institution of pre-kindergartens allows us to overcome this endogeneity issue by exogenously expanding the availability of a cheaper childcare service to a group of families whose only requirement is that their child must be born within a certain cut-off date. Therefore, as long as the child’s exact date of birth is orthogonal to the household’s observable and unobservable characteristics that may affect the mother’s labour supply choices, we are able to identify a causal relationship.

Note that, because our data contain no information about actual use of pre-kinder-

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<sup>13</sup>According to OECD data, the average age of first child bearing in Italy was in 2009 29.9 years old, the second highest after Germany and the UK (30 years old). The average across all OECD countries was instead 27.8.

garten, we are only able to identify the effect of pre-kindergarten *eligibility* rather than the effect of actual enrolment, i.e. we identify an *Intention To Treat* effect. Because not all eligible families used the service (the take-up rate was about 40% on average in the last two years of pre-kindergarten), the parameter that we identify will be smaller in magnitude than the actual treatment effect. Yet, this parameter is particularly interesting from a policy perspective: as pre-kindergarten is not compulsory and childcare and labour supply decisions are generally taken simultaneously, the policy maker will be most interested in the effect of providing families with the *possibility* of sending the child to school one year earlier.

In this paper we aim to exploit the discontinuity in the rule that determines eligibility for pre-kindergarten in two ways in order to identify and estimate the parameter of interest. The first strategy is based on a standard *Sharp Regression Discontinuity* (SRD) (Thistlethwaite and Campbell, 1960), while the second one is a *Difference in Discontinuities* (Diff in Disc), a variation of the standard regression discontinuity in the spirit of Grembi et al. (2012).

## 5.1 Sharp Regression Discontinuity

The structure of the policy scheme allows us to implement a *Sharp Regression Discontinuity Design* (SRD) based on the exact date of birth of the youngest child in the household. Indeed, for the year 2005/06 and from 2009/10 until today, eligibility for pre-kindergarten is determined by the child’s date of birth through a discontinuous rule: the law provides that while a child born on 30 April can enrol in kindergarten when she is 29 months old, a child born the day after, can only go to kindergarten one year later (equation (11)).

$$PK_{it} = \begin{cases} 1 & \text{if } dob_i \leq 30/04/t - 3 \\ 0 & \text{otherwise} \end{cases}. \quad (11)$$

Exploiting this assignment rule, we aim to compare children whose date of birth falls within a small interval of the cut-off point, that is  $30/04/t - 3$ ; the underlying idea being that these children, and their mothers, will be identical for all characteristics with the exception of eligibility for pre-kindergarten.

We therefore regress the probability of the mother of child  $i$  being employed (or in search of a job) on a running variable that we build as the distance in days between the child’s date of birth and the cut-off point. This distance will be positive for children born before the cut-off date (and thus eligible) and negative for children born after (and thus

not eligible). Let  $EM_i = 1$  if the mother of child  $i$  (who has no younger children in the household) is employed, and let  $p_i$  be a continuous variable measuring the number of days of distance between the child’s date of birth and the cut-off point of the  $30/04/t - 3$ , we can then estimate a regression of the type:

$$Pr(EM_{it}) = f(p_i) + \beta PK_{it} + \epsilon_{it} \quad (12)$$

where  $f(\cdot)$  is a smoothing function and the parameter  $\beta$  will provide an estimate of the causal effect of *eligibility* for pre-kindergarten of the youngest child in the household on the mother’s probability of being employed:

$$\hat{\beta}_{SRD} = \lim_{p_i \rightarrow 0^+} E(EM_{it}|p_i) - \lim_{p_i \rightarrow 0^-} E(EM_{it}|p_i). \quad (13)$$

We run the same regressions also on a labour market *participation* indicator, on the stated reservation wage of unemployed mothers, on the actual wages paid to employed mothers and on their weekly hours worked.

## 5.2 Difference in Discontinuities

As described in Section 3, a child born by the end of April is entitled to enrol in pre-kindergarten in the school year in which she turns 3, but also to pre-school in the school year in which she turns 6. One may therefore be concerned that the relevant treatment is not eligibility for pre-kindergarten but rather prospective eligibility for pre-school. Indeed, the latter will also cause a drop in education costs, in that primary school is generally cheaper than kindergarten, although the difference is much smaller than that between day care and kindergarten (Figure 3). Therefore, one can imagine that parents anticipate this future saving and, by smoothing consumption, accept to pay a bit more for childcare when the child is below 3. If this were the case, the effect recovered through SRD would be an overestimate of the true effect of pre-kindergarten in that it would also include an anticipated effect of pre-school.

To overcome these doubts and isolate the effect of pre-kindergarten from other confounding effects caused by policies that share the same eligibility rule, we exploit the changes in the policy criteria and implementation that we described in Section 3. We can estimate the effect of eligibility for pre-kindergarten in the years in which the eligibility cut-off for pre-kindergarten and pre-school were the same and in the years in which they were different, and then take the difference between the two (*Difference in Discontinuities*).



The estimating equation will be:

$$Pr(EM_{it}) = \sum_{k=0}^q (\delta_k p_i^k) + PK_i \sum_{k=0}^q (\gamma_k p_i^k) + T_t \left[ \sum_{k=0}^q (\alpha_k p_i^k) + PK_i \sum_{k=0}^q (\beta_k p_i^k) \right] + \epsilon_{it} \quad (14)$$

where  $p_i$  is again the number of days of distance between the child's date of birth and the cut-off point of the 30/04/ $t - 3$ ;  $T_t$  is an indicator variable for whether pre-kindergarten with 30 April cut-off is in place in year  $t$ ,  $T = \mathbb{1}(t = 2005/06 \text{ or } t \geq 2009)$ ; and  $q$  is the order of polynomial chosen for approximation of the smoothing function, we present estimates for  $q = [1, 3]$ . In this setting the coefficient of interest is  $\beta_0$ :

$$\hat{\beta}_{\text{diff-in-disc}} = \left[ \lim_{p_i \rightarrow 0^+} E(EM_{it}|p_i, T = 1) - \lim_{p_i \rightarrow 0^-} E(EM_{it}|p_i, T = 1) \right] + \left[ \lim_{p_i \rightarrow 0^+} E(EM_{it}|p_i, T = 0) - \lim_{p_i \rightarrow 0^-} E(EM_{it}|p_i, T = 0) \right] \quad (15)$$

which represents a Diff-in-Disc Intention to Treat ( $ITT_{\text{diff-in-disc}}$ ) parameter.

Again, we run the same regressions on labour market *participation* and on the stated reservation wage.<sup>14</sup>

## 6 Estimation

For the SRD estimates, we report estimates of the  $\beta$  coefficient based on both parametric and non-parametric specifications of the conditional mean of the outcomes. For the parametric estimation we present results for first and second order polynomial approximations allowing the slope and the concavity of the function to change independently on each side of the cut-off. Moreover, we also use a non-parametric specification, which allows us to relax most of the assumptions required by the parametric models (most importantly, the choice of the order of polynomial). Following [Hahn et al. \(2001\)](#), we employ a non-parametric *Local Linear Regression* (LLR) to approximate the function  $f(\cdot)$  of equation (12) as the forcing variable approaches the cut-off point; again, the difference between the two functions at the cut-off point will provide the estimate of the treatment effect. For all three specifications we decided to trim the data at six months from the cut-off, which leaves us with a sample of about 10,500 mothers.

<sup>14</sup>Diff-in-disc estimates of the effect on paid wages and on the number of hours worked by employed mothers are available from the authors upon request.

The LLR on the two sides of the cut-off is estimated using Triangular Kernel weights so that observations that are closer to the cut-off point will carry a larger weight: [Fan and Gijbels \(1996\)](#) proved that Triangular Kernel weighted local linear regression performs optimally at the window boundary and thus also at the cut-off where the SRD requires most precision. The only choice required in the LLR estimation remains that of the bandwidth: a larger bandwidth would improve the precision of the estimates (lower variance) but return more biased estimates of the treatment effect. In this paper we do not use the optimal bandwidth derived by [Imbens and Kalyanaraman \(2010\)](#) through plug-in methods (this minimizes the Expected Squared Error Loss around the cut-off point) because this produces under-smoothing and thus very noisy and unstable estimates. Rather, we decide to allow for the risk of having more bias but improve the smoothness of the relationship between the child’s date of birth and the mother’s employment status by choosing a larger bandwidth of 60 days. Anyway, we systematically report results obtained with our chosen bandwidth together with its half and its double and, in the specification checks, we show that our main results do not vary when we change the value of the bandwidth employed.

When we estimate the effect of pre-kindergarten through the Diff-in-Disc approach, we only use parametric approximations of the smoothing function and present estimates for first, second and third order polynomial approximations.<sup>15</sup> The size of the window around the cut-off considered is the same as for the SRD estimates but the sample size is now almost twice as big because we are including in the regression seven years instead of four.

Finally, in all our specifications, we account for the possibility that there may be spatial and serial correlation in the error terms by clustering standard errors at the level of region of residence and school year ([Cameron and Miller, 2015](#)).

## 7 Results

### 7.1 Sharp Regression Discontinuity

Results obtained through SRD are presented in Figures 4 to 6 and in Tables 5 to 8 for all the main outcome variables.

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<sup>15</sup>[Grembi et al. \(2012\)](#) refer to this estimation strategy as *splines* because the polynomials approximate the function on small enough intervals of data, yet the specification is fully parametric.

The figures show the discontinuity in the outcome variable at the cut-off date 30/04/ $t-3$ , which determines admission to pre-kindergarten in the academic year  $t/t+1$ . The horizontal axis represents the distance from the cut-off date of birth ( $p_i$ ), observations to the right of the cut-off correspond to children who were born *before* the cut-off, i.e. are “old enough” to be eligible to attend the childcare service; observations to the left of the cut-off, conversely, represent children who were born *after* the relevant cut-off date, and so are “too young” to be eligible. The three graphs show the estimated discontinuity for the first and second order polynomial approximations and for local linear regression with triangular Kernel weights and a bandwidth of 60 days to sufficiently smooth the function  $f(\cdot)$ . The grey lines are the estimated 95% level confidence intervals. The dots of the underlying scatterplots show the mean outcome in bins of one week’s width (Lee and Lemieux, 2010). The discontinuities shown in the graphs correspond to the estimates reported in the tables. The reported ITT coefficient measures the height of the “jump” at the cut-off point, while the baseline is the value of the outcome variable at the discontinuity for the non-eligible individuals (the left-hand side of the discontinuity).

Consider first the effect of eligibility for pre-kindergarten on mothers’ participation in the labour market: the graphs in Figure 4 show that there is indeed a large and significant difference in the likelihood of participating in the labour market between mothers of children born right before 30 April and mothers of children born right after. Moreover, the magnitude of this discontinuity is consistent across the three specifications proposed. Table 5 shows that this difference amounts to 5.2-7.9 percentage points depending on the specification chosen, over a baseline labour market participation rate of about 58% (i.e. a 10% increase). This positive and sizeable effect is consistent with our theoretical prediction of Proposition 1.

We then turn to the analysis of the effects of eligibility for pre-kindergarten on actual employment of the mothers (Proposition 4): the results, illustrated in Figure 5 and detailed in Table 5, show that the overall impact is positive and sizeable though less significant in statistical terms. Indeed, Table 5 shows that the magnitude of the effect ranges between 4.4 and 5.5 percentage points over a baseline employment rate of about 52%. The estimates appear to be stable across different empirical specifications, but hardly significant at standard statistical levels.

The finding that increased participation translates into increased employment suggests that the theoretical ambiguity highlighted in Proposition 4 seems to be solved in the

direction of there being a positive effect on employment of reducing the cost of childcare. To understand whether this is only due to the increase in participation rates or whether instead there have also been changes in the job acceptance rules of women, we also estimate the effect of pre-kindergarten eligibility on the stated reservation wage of unemployed women. The results are illustrated in Figure 6 and detailed in Table 7. These show that eligibility for pre-kindergarten determines a sharp drop in the stated reservation wage which passes from about 850 euros per month for the mothers of non-eligible children to about 730 euros per month for the mothers of eligible children (a 14% drop). Note that the magnitude of these effects, while large in absolute terms, is smaller than the difference between the average cost of daycare and that of kindergarten. The reduction in the reservation wage is driven by the fact that employed mothers benefit more than unemployed ones from having access to pre-kindergarten. This happens because unemployed mothers already pay low rates for day care so that the marginal decrease in price they enjoy is lower (in terms of our model,  $s$  is “sufficiently small”).

While no similar estimates are available for comparison when we look at the reservation wage, we can compare the effects on participation and employment rates to the previous literature summarized in Table 1. It turns out that our estimated effects are quite large: considering that the take-up rate is less than 50%, the actual treatment effect amounts to almost twice the reported coefficients. The magnitude of these effects is comparable to those found by Barua (2014) for the US, and to those found by Berlinski and Galiani (2007); Berlinski et al. (2011) for Argentina and by Schlosser (2011) for Israeli Arabs. On the other hand, estimates for continental and Northern Europe tend to be significantly smaller (Goux and Maurin, 2010; Havnes and Mogstad, 2011). We may further compare the magnitude of our estimated effects to those studies which directly addressed changes in the price of childcare. Blau and Currie (2006) report that the elasticity of female labour supply to childcare price ranges between -0.1 and -0.2. Our results are in line with this literature in that the implied Marshallian elasticity is about -0.146.

In Table 8 we estimate the effect of pre-kindergarten eligibility on the weekly hours worked by mothers. The results indicate a decrease in the number of hours worked, but this effect does not hold in the non parametric estimation. Moreover, in terms of magnitude, the effect estimated in the parametric specifications is quite small: a decrease in the price of childcare of about 270 euros leads employed mothers to work about one and a half hours less per week. This confirms that adjustments of labour supply on the intensive margin are always limited as shown in the previous literature (Blundell et al., 2013). In turn, our results on hours worked suggest that the income effect, if any,

associated with the provision of low cost childcare prevails over the substitution effect, thus reducing mothers' working hours.

As a final exercise we also estimated the effects on wages paid to employed mothers. If the possibility of using pre-kindergarten decreased the reservation wage of unemployed mothers, we would expect that women accepted lower paid jobs and so that the wages effectively paid decreased too. In Table 8 we see that pre-kindergarten eligibility generated a small, non statistically significant, drop in wages paid to mothers of eligible children of about 30 euros.

## 7.2 Difference in Discontinuities

In Figures 7 and 8 and in Table 9 we present the results of the Difference in Discontinuities estimation exercise.

On the vertical axis of the figures we now have the difference in outcomes between the period in which pre-kindergarten was in place with the cut-off at 30 April ( $T = 1$ ) and the period in which it was abolished or had a different eligibility requirement ( $T = 0$ ). Therefore the line to the left of the cut-off should not be different from zero, while that to the right is expected to be positive at the cut-off and decrease to zero as we move away from the cut-off.<sup>16</sup> As before, individuals to the left of the cut-off are the non-eligible ones, while those to the right are the eligible ones, i.e. mothers of children born before 30 April. The three graphs correspond to the three order of polynomial approximations employed. As for the SRD graphs, the grey lines are the estimated 95% level confidence intervals and each dot in the underlying scatterplot represents the mean of the outcome variable in bins of one week's width. The magnitude of the observed discontinuities is reported in Table 9.

Visual inspection of the graphs already suggests that the effect estimated through diff-in-disc is large and significantly different from zero, both for participation in the labour market and for employment. Moreover, the magnitude of the effects seems consistent across the different polynomial specifications. Indeed, the regression results reported in Table 9 reveal that the effect of pre-kindergarten eligibility on participation is between 10.4 and 15.6 percentage points, while that on employment is between 8.1 and 12.6 percentage points. The estimated effect on the reservation wage is instead less

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<sup>16</sup>Consider indeed that above 120 days from the cut-off, children are no longer pre-kindergarten eligible but kindergarten eligible, so the difference between the pre-kindergarten period and the non pre-kindergarten period should be zero for them. This prediction is in line with what we observe in the graphs.

precisely estimated than in the case of SRD, but it is still negative and not different in statistical terms. Compared with the SRD results, the diff-in-disc effects on participation and employment are considerably larger, which contradicts the theoretical reasoning for using a diff-in-disc approach. Indeed, one would expect the SRD to be capturing an additional positive effect of pre-school and so to be overestimating the effect of pre-kindergarten. Instead, Figure 9 shows that the (anticipation) effect of pre-school (in the central panel of the figures) is not significantly different from zero, but negative. This implies that taking the difference between the discontinuities in the two periods leads to an overestimation of the effect of pre-kindergarten. Assuming that this is due to noise in the estimates, we prefer to use the standard SRD strategy described in sub-section 5.1.

### 7.3 Heterogeneous effects

To conclude our empirical analysis, we investigate several potentially important dimensions of heterogeneity in the effects.

First, in Table 10, we consider differences in the local labour market, and in particular in local labour demand across different regions. This exercise tests the predictions of our theoretical Proposition 2 and helps to understand what happens to employment. To proxy for the local probability of receiving a job offer we build a variable that is the ratio of the yearly number of vacancies per region (released by Istat) and the corresponding number of unemployed people, that is our vacancy rate. We then estimate the effects of pre-kindergarten separately on those regions in which the job finding rate is above the median and those in which it is below. The results reveal that, consistently with the predictions of our model, the increase in participation and employment is significantly larger where the vacancy rate is higher. Indeed, eligibility for pre-kindergarten increases participation by up to 13.7 percentage points where the vacancy rate is high, while the effect is hardly positive where it is low. Similarly, employment increases by up to 11.3 percentage points in labour markets where there is less congestion and is unaffected where there is more. The magnitude of the effects for high labour demand areas is very much in line with that of the effects estimated for the US (Cascio, 2009; Barua, 2014), as indeed are the baseline participation and employment rates.

Following the prescriptions of our model, the second dimension of heterogeneity that we consider is the level of education of the mothers. In Table 11 we split the sample into three subsamples according to the highest level of education of the mother. It now appears that the magnitude of the effect of pre-kindergarten availability is generally higher for less-educated mothers, as predicted by Proposition 3, but that the largest effects are

obtained on mothers with a high school diploma, presumably because these are the ones who marginally gain the most from entering the labour market.

A crucial dimension of heterogeneity that we explore is that of family income. Our model predicts that the reservation wage may increase in cases in which the implicit discount in passing from daycare to kindergarten is very low. We argued that this may happen for low income families because these enjoy large discounts for day care (Table 2). To test this prediction we split our sample according to overall family income (Table 13). The results obtained interestingly show that the estimated average increase in participation and employment is mainly driven by higher income families. Among less affluent families indeed the stated reservation wage remains unaffected (it even increases under second order polynomial parametric approximation).

As a final exercise, we try to understand how the household structure interacts with the provision of low cost childcare by splitting our sample between married and single mothers (Table 12). It turns out that the effect is concentrated among married women, whose propensity to participate in the labour market, and whose job search intensity, is traditionally lower. This result is particularly significant from a policy perspective because it shows that lowering the cost of childcare can indeed stimulate the labour market participation of a slice of the population that has traditionally been excluded.

## 8 Specification Checks

In order for the Regression Discontinuity Design to yield consistent estimates the counterfactual conditional distribution of the outcome variable must be sufficiently smooth over the date of birth, i.e. the probability that a mother will decide to search for a job and find one is, in the absence of the policy, 'continuously' related to the age of the child (if we were to look at a *wider* window, we would expect such probabilities to be increasing over the age of the child, while they appear essentially flat when we restrict our attention to a 1-year-of-age window). While this assumption cannot be tested directly, it is common practice to assess its feasibility by checking that other variables usually associated with the outcome of interest do not also vary discontinuously at the threshold (Imbens and Lemieux, 2008). Figure 10 and Table 14 show that the estimated discontinuities for the main socio-economic characteristics of the mothers are not statistically significant.<sup>17</sup>

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<sup>17</sup>One may be concerned about the geographical distribution of the individuals; indeed, it appears that at the cut-off there are fewer women from the South on the right-hand side of the cut-off (eligible) than

Second, one may be concerned that the results of the SRD exercise are driven by some ‘manipulation’ of the forcing variable so that individuals self-select into the eligible group in order to benefit from the policy intervention. If this were the case, the SRD results would be biased and likely overestimate the impact of the policy (under the assumption that those who deliberately self-select into the eligible group are the most sensitive to the policy intervention). In this setting, a manipulation of the running variable would mean that mothers strategically choose when to deliver their baby so as to benefit from the possibility of anticipating entry to kindergarten. Although this may seem unlikely, we formally test for the presence of manipulation of the forcing variable using the test designed by [McCrary \(2008\)](#). This is based on estimating the discontinuity at the cut-off in the density function of the running variable through Local Linear Regression techniques with triangular Kernel weights. [Figure 11](#) shows the estimated discontinuity in the density of the forcing variable and confirms that the population density is smooth across the cut-off.

Our third robustness check is then a test of the sensitivity of our non-parametric results to the choice of the bandwidth. [Figure 12](#) shows that the estimated coefficients, both for participation and for employment, are very unstable and noisy for small values of bandwidth and then stabilize for quite large values (above 90 days). In particular, the figures show that our most preferred non-parametric specification is likely to provide only a conservative estimate of the true effect as this actually appears to get larger and statistically more significant for values of the bandwidth greater than the one we employ (60 days).

To make sure that our discontinuity is not due to fuzziness in the data, we estimate the same probabilities at the cut-off date for regular eligibility for kindergarten (turning 3 by 31 December of the academic year  $t$ ). The absence of any significant discontinuity at the point of eligibility for kindergarten ([Table 15](#)) is a mere consequence of the fact that families can now anticipate the entry of their kids to kindergarten so that a child born on  $1/1/t - 2$  no longer has less chance of getting into kindergarten than a child born on  $31/12/t - 3$ .

As a final check, we estimate our model on fathers: [Table 16](#) shows that the effects on the left-hand side. If anything, this would bias our results downwards because it lowers the weight of the eligible individuals in the South. Yet, as the overall result is driven by women in the North while the effect is essentially null in the South, we can be quite confident that such a small discontinuity does not bias our main results.



on fathers are null both for their participation and for their actual employment status. This last finding reassures us that there is no need to include fathers in the decision making model and to build a household model of labour market participation and confirm the widely known fact that Italian women are typically the main caregivers inside the household.

## 9 Conclusions

Female labour market participation and employment rates in Italy are among the lowest across Europe and the OECD countries. At the same time, public supply of childcare services remains scarce, with private services being very costly. Despite the clear positive correlation between these two variables, it remains unclear whether it is the *undersupply* of childcare services that induces mothers to stay home and look after their children, or instead, whether it is the inadequate provision of childcare services that is caused by a lack of *demand* for them because women prefer to look after their children themselves. Our paper investigates this relationship providing first a theoretical contribution, a job search model that accounts for the effects of variations in the price of childcare services on maternal labour supply, and second a robust empirical analysis that allows us to identify such causal effects.

Our theoretical model innovates the existing literature in family economics by incorporating the mother's labour supply choices in a dynamic framework, accounting for the fact that job search requires time and mothers need to rely on childcare services not only when they have a job but also when they are looking for one. A similar model delivers a novel prediction, i.e. that lowering the price of childcare may prompt mothers not to accept low paid jobs by decreasing the cost of being unemployed. To avoid a similar distortion, childcare has to be provided at a sufficiently lower cost for unemployed mothers.

We further provide empirical evidence on the effects of providing low cost childcare to mothers of 2-year-old children. Exploiting the discontinuities in the rules that determine access to pre-kindergarten in Italy, we estimate that the policy leads to an increase in participation of mothers in the labour market of about 6 percentage points, which translates into an increase in the probability of actually holding a job of about 5 percentage points. We show that the latter effect is due not only to the mechanical effect produced by the increase in the number of women in the labour market, but also to a significant drop in the reservation wage of unemployed women.

From a policy perspective, the present paper provides strong and robust evidence that increasing the provision of low cost childcare services generates a significant increase in female labour supply, especially among the categories that are most under-represented in the labour force, namely married and less-educated women. For the other women, though, the provision of low cost childcare services may represent a sort of income subsidy and may not produce any positive effect in terms of stimulating labour supply. For this reason a transfer conditional on the mother's working condition, in the spirit of those adopted in the US or in the UK,<sup>18</sup> might be more effective in encouraging female labour supply. Moreover, the fact that pre-kindergarten eligibility causes a significant drop in the reservation wage suggests that a similar policy may also benefit employers who can hire women at lower cost. On these grounds, an optimal policy may be the one that leads firms to internalize these benefits, for example by giving subsidies to those that provide childcare facilities directly.

To conclude, one should remember that the possibility of attending childcare facilities instead of being cared for inside the household is likely to have positive effects on children's development, as suggested by the most recent literature ([Havnes and Mogstad, 2011](#); [Herbst, 2013](#)). For this reason an exhaustive analysis of the overall welfare effects of increasing the supply of public childcare facilities would entail studying the effects on children's development as well. This question is currently beyond the scope of this paper and will be addressed in future research.

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<sup>18</sup>The Earned Income Tax Credit in the United States and the tax credit for childcare costs within the Working Tax Credit scheme in the United Kingdom.

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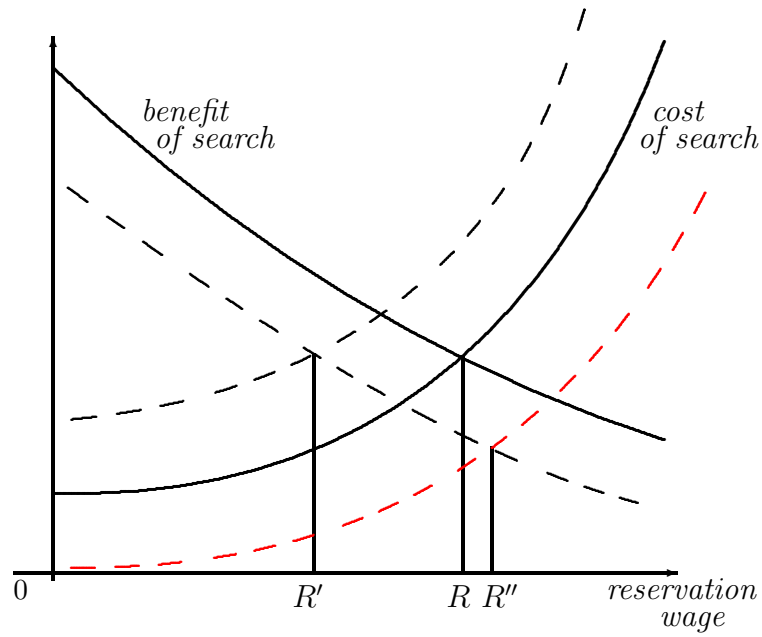
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Table 1: Recent literature on the relationship between childcare services and female labour supply

Authors	Country	Children's age	Empirical Strategy	Labour supply measure	Effect on mothers' labour supply	Baseline	Effect on weekly hours worked	Baseline
Gelbach (2002)	US	5	IV (quarter of birth)	Employment	+4 p.p.	70%	+2.71	15.6
Berlinski and Galiani (2007)	Argentina	3-5	DD	Employment	+7-14 p.p.	36%	Null	32
Cascio (2009)	US	5	DD	Employment	+7.5 p.p. (single mothers only)	58%	+2.78 (single mothers only)	21.85
Goux and Maurin (2010)	France	2 and 3	Fuzzy RDD (date of birth)	Employment	+3.6 p.p. (single mothers of 3-year-olds only)	79.7%	NA	NA
Fitzpatrick (2010)	US	4	Combined Sharp RDD and DD (date of birth)	Employment	Null	56%	Null	26
Schlosser (2011)	Israel (Arabs)	2-4	DD	Participation and employment	+7.1 - +11.7 p.p. on part. +8.1 - +12.6 p.p. on empl.	10% 8.4%	+0.73	4.45
Berlinski et al. (2011)	Argentina	5	Fuzzy RDD (date of birth)	Employment	+6.6 p.p.	37%	+7.8	12.17
Havnes and Mogstad (2011)	Norway	3-6	DD	Employment	Null	24.5%	NA	NA
Herbst (2013)	US	0-12	DDD	Employment	+4.4 pp	21.4%	NA	NA
Barua (2014)	US	5-6	IV (quarter of birth)	Employment	+11 p.p. (married mothers only)	59%	+2.91	17.04

Figure 1: Effects of a price reduction of childcare on mother's reservation wage



**Notes:** The cost of an additional period of search is an increasing function of the reservation wage, while the benefit of search is decreasing, as depicted in the picture. The reservation wage  $R$  is the wage at which the cost and benefit of search are equal. Lowering the price of childcare unambiguously reduces the benefit of search, since there is less incentive to wait for a better offer. The effect on the cost of search for another period is instead ambiguous. If the price reduction benefits more the employed mother, the cost of waiting for a better offer is higher (the dashed black line). In this case the lower benefit and the higher cost reduce the mother's reservation wage to  $R'$ . If, instead, the price reduction benefits more the unemployed mother, the cost of search decreases (the dashed red line). In this case, the reservation wage increases to  $R''$  as long as the cost of search decreases more, in absolute terms, than the benefit of search.

Table 2: Monthly rates for full time day care and kindergarten in the municipality of Rome (euro)

ISEE annual income	Day care fees	Kindergarten fees	Discount %
$\leq 5,165.00$	34.60	0	100
5,165.01 – 15,000.00	34.60 - 111.6	30 - 43	13.3 - 61.5
15,000.01 – 25,000.00	111.6 - 184.4	43 - 50	61.5 - 73
25,000.01 – 30,000.00	184.4 - 222.9	50 - 55	73 - 75
30,000.01 – 45,000.00	222.9 - 303.7	55 - 80	75 - 74
$\geq 45,000.01$	303.7	80	74

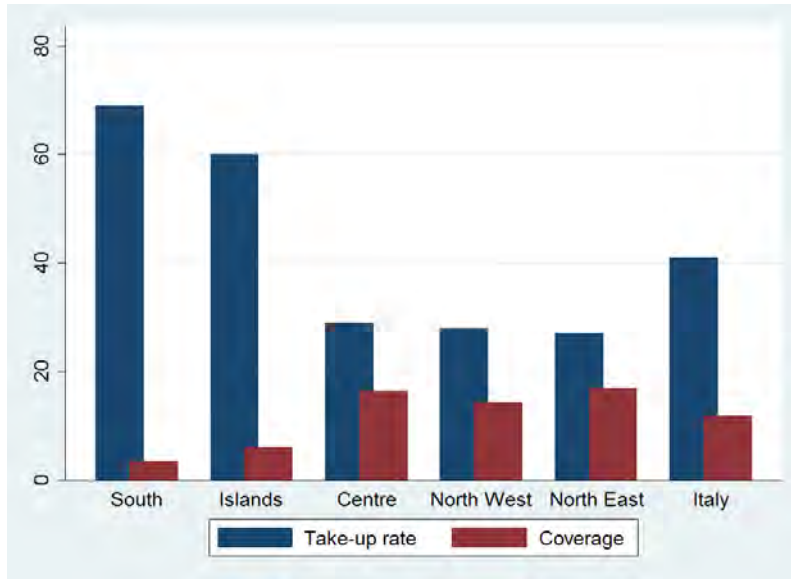
**Notes:** Fees are set by single municipalities. Kindergartens are free and fees are only required for school meals. Discount is the implicit discount of moving from day care to kindergarten.

Table 3: Summary of rules for access to childcare services

School year	Access to kindergarten, child turns 3 by:	Access to primary school, child turns 6 by:
Until 2002/2003	31 December	31 December
2003/2004 - 2005/2006	30 April	30 April
2006/2007 - 2007/2008	28 February	30 April
2008/2009	31 December	30 April
2009/2010 onwards	30 April	30 April



Figure 2: Take-up and childcare services coverage rates, 2011



**Notes:** The take-up rate is computed as the number of children born between 1 January and 30 April 2008 who enrolled in pre-kindergarten, divided by one third of the total number of children born in 2008. Data on enrolments in pre-kindergarten are taken from [Istituto Degli Innocenti \(2011\)](#). The coverage rate is computed by Istat as the number of 2-year-old children attending public childcare facilities, divided by the number of 2-year-olds.

Figure 3: Childcare fees paid by a child born on the 30 April and by a child born 1 May.

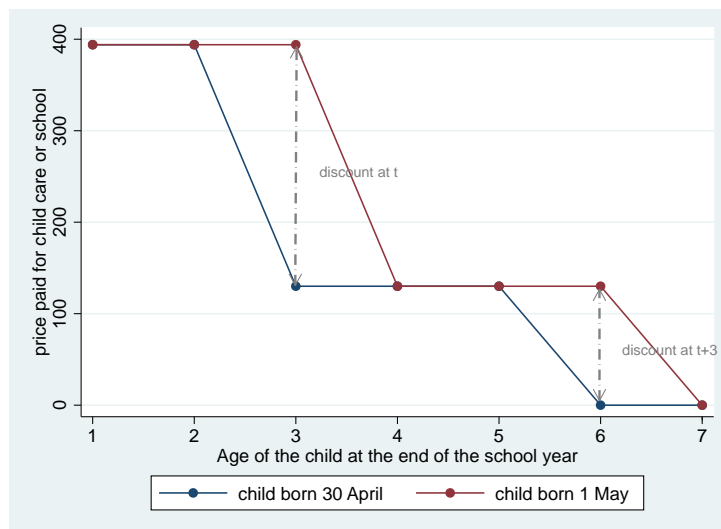
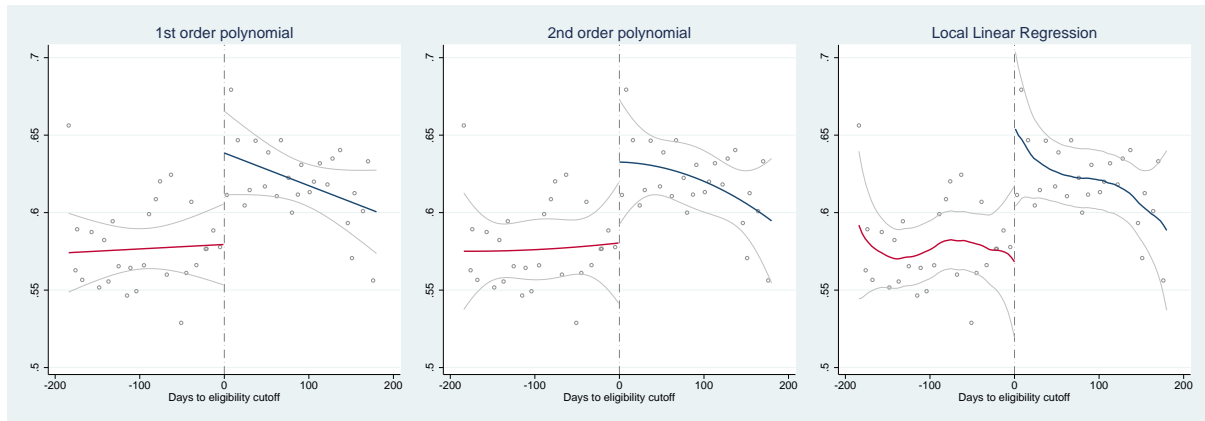


Table 4: Descriptive Statistics

	Non eligible	Eligible	Total
Age	34.07 (5.217)	34.67 (5.108)	34.35 (5.174)
Single	0.142 (0.349)	0.138 (0.345)	0.140 (0.347)
Household size	3.804 (0.907)	3.849 (0.888)	3.825 (0.898)
Compulsory school or less	0.329 (0.470)	0.331 (0.470)	0.330 (0.470)
High school	0.467 (0.499)	0.467 (0.499)	0.467 (0.499)
Higher Education	0.203 (0.403)	0.203 (0.402)	0.203 (0.402)
Labour market participation	0.577 (0.494)	0.619 (0.486)	0.597 (0.491)
Employed	0.519 (0.500)	0.556 (0.497)	0.537 (0.499)
Hours worked (weekly)	26.61 (13.57)	26.21 (13.78)	26.42 (13.67)
Monthly wage	1060.9 (440.7)	1067.3 (425.4)	1064.1 (433.2)
Monthly reservation wage	804.6 (263.7)	767.1 (248.9)	785.5 (256.8)
Observations	10577		

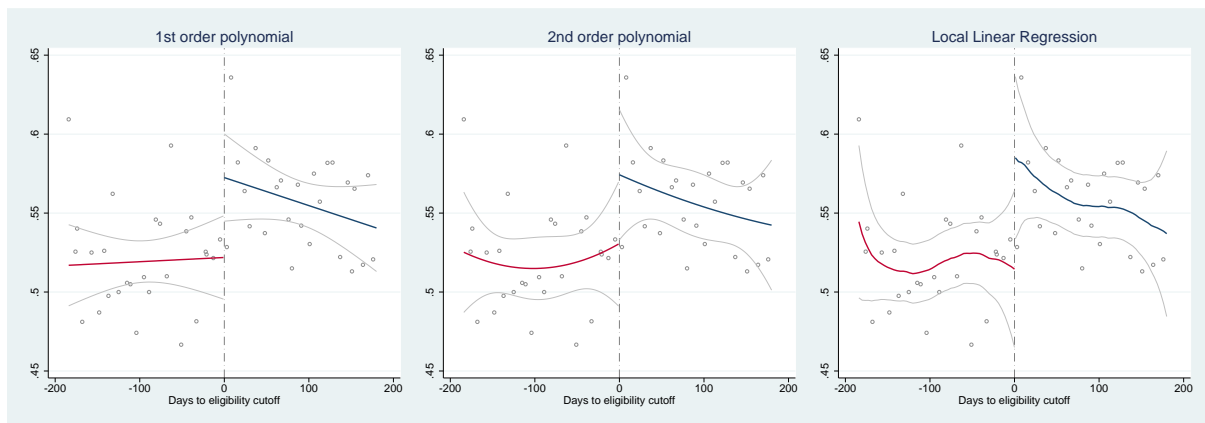
mean coefficients; sd in parentheses; main regressions sample

Figure 4: Effect of eligibility for pre-kindergarten on mothers' labour market participation (Sharp Regression Discontinuity)



**Notes:** Each dot represents children born in one week. Dots to the right of the cut-off are children eligible to pre-kindergarten. The graphs show first and second order polynomial approximations, and local linear regression approximation with a bandwidth of 60 days.

Figure 5: Effect of eligibility for pre-kindergarten on mothers' employment (Sharp Regression Discontinuity)



**Notes:** Each dot represents children born in one week. Dots to the right of the cut-off are children eligible to pre-kindergarten. The graphs show first and second order polynomial approximations, and local linear regression approximation with a bandwidth of 60 days.

Table 5: Effect of eligibility for pre-kindergarten on mothers' labour market **participation** and **employment** (Sharp Regression Discontinuity)

	(1)	(2)	(3)	(4)	(5)
	1st order polynomial	2nd order polynomial	Local Linear Regression	Local Linear Regression	Local Linear Regression
<b>Participation</b>					
ITT	0.059*** (0.010)	0.052** (0.027)	0.067* (0.036)	0.079 (0.050)	0.063** (0.026)
Baseline	0.579	0.580	0.568		
Bandwidth	180	180	60	30	120
Observations	10577	10577	10577	10577	10577
<b>Employment</b>					
ITT	0.051*** (0.009)	0.044 (0.030)	0.055 (0.036)	0.053 (0.055)	0.055** (0.025)
Baseline	0.522	0.531	0.514		
Bandwidth	180	180	60	30	120
Observations	10577	10577	10577	10577	10577

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Figure 6: Effect of eligibility for pre-kindergarten on unemployed mothers' **reservation wage** (Sharp Regression Discontinuity)



**Notes:** Each dot represents children born in one week. Dots to the right of the cut-off are children eligible to pre-kindergarten. The graphs show first and second order polynomial approximations, and local linear regression approximation with a bandwidth of 60 days.

Table 6: Effect of eligibility for pre-kindergarten on unemployed mothers' **reservation wage** (Sharp Regression Discontinuity)

	(1)	(2)	(3)	(4)	(5)
	1st order polynomial	2nd order polynomial	Local Linear Regression	Local Linear Regression	Local Linear Regression
<b>Monthly reservation wage</b>					
ITT	-93.327** (44.587)	-120.998*** (90.578)	-159.821* (94.233)	-221.643** (98.727)	-108.510 (66.867)
Baseline	833.208	853.103	877.394		
Bandwidth	180	180	60	30	120
Observations	566	566	566	566	566

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Table 7: Effect of eligibility for pre-kindergarten employed mothers' **wages** (Sharp Regression Discontinuity)

	(1)	(2)	(3)	(4)	(5)
	1st order polynomial	2nd order polynomial	Local Linear Regression	Local Linear Regression	Local Linear Regression
<b>Monthly wage</b>					
ITT	-34.943 (43.221)	-30.802 (35.817)	-71.898 (57.417)	-152.206 (93.315)	-25.113 (40.575)
Constant	1,078.858	1,089.992	1107.339		
Bandwidth	180	180	60	30	120
Observations	3536	3536	3536	3536	3536

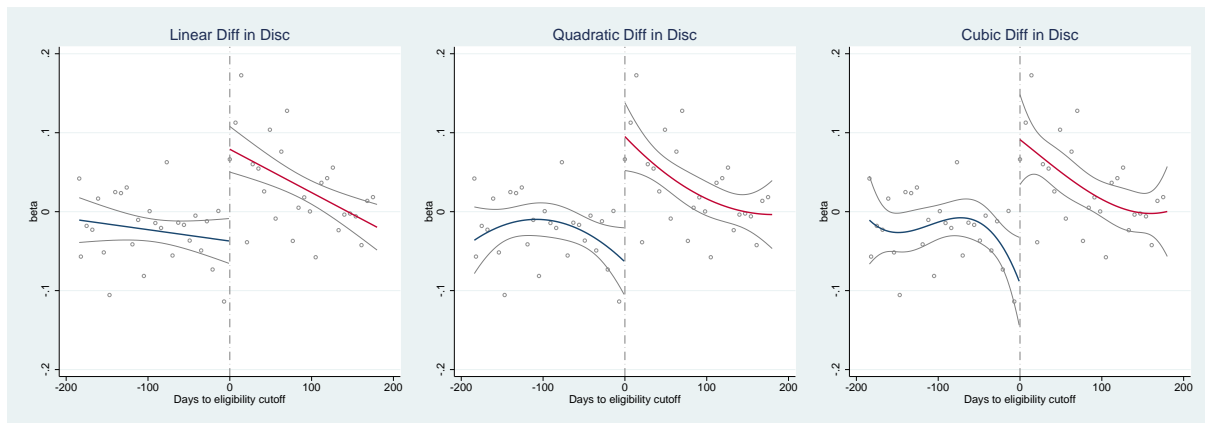
**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Table 8: Effect of eligibility for pre-kindergarten on mothers' labour supply, **intensive margin** (Sharp Regression Discontinuity)

	(1)	(2)	(3)	(4)	(5)
	1st order polynomial	2nd order polynomial	Local Linear Regression	Local Linear Regression	Local Linear Regression
<b>Weekly hours worked</b>					
ITT	-1.633*** (0.210)	-1.392** (0.693)	0.983 (1.402)	-2.017 (2.059)	-1.468 (1.114)
Baseline	26.998	27.117	27.214		
Bandwidth	180	180	60	30	120
Observations	5671	5671	5671	5671	5671

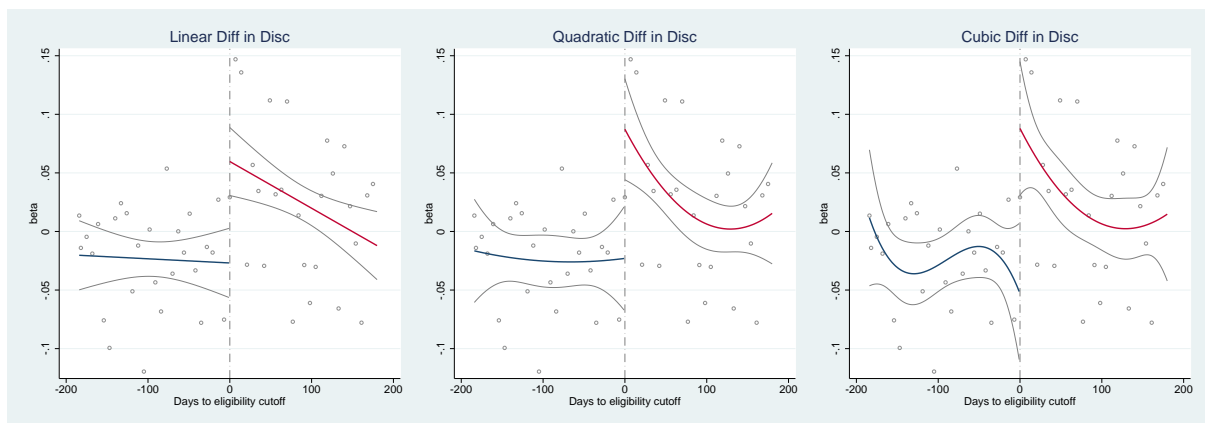
**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Figure 7: Effect of eligibility for pre-kindergarten on mothers' labour market participation (Difference in Discontinuities)



**Notes:** Each dot represents children born in one week. Dots to the right of the cut-off are children eligible to pre-kindergarten. The graphs show first, second and third order polynomial approximations of the treatment effect.

Figure 8: Effect of eligibility for pre-kindergarten on mothers' employment (Difference in Discontinuities)



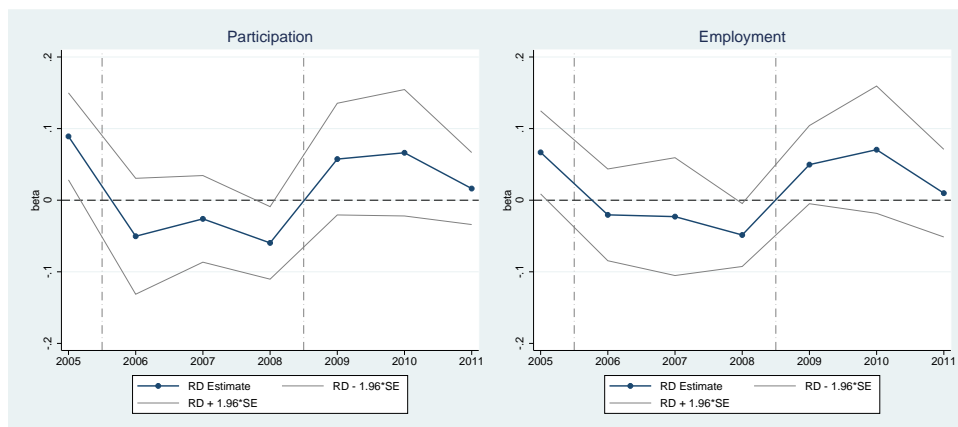
**Notes:** Each dot represents children born in one week. Dots to the right of the cut-off are children eligible to pre-kindergarten. The graphs show first, second and third order polynomial approximations of the treatment effect.

Table 9: Effect of eligibility for pre-kindergarten on mothers' labour market **participation** and **employment** and on **reservation wage** (Difference in Discontinuities)

	(1)	(2)	(3)
	1st order polynomial	2nd order polynomial	3rd order polynomial
<b>Participation</b>			
ITT	0.104*** (0.015)	0.141*** (0.023)	0.156*** (0.027)
Observations	19078	19078	19078
<b>Employment</b>			
ITT	0.081*** (0.007)	0.097*** (0.028)	0.126*** (0.008)
Observations	19078	19078	19078
<b>Reservation wage</b>			
ITT	-87.094* (50.101)	-145.867 (154.952)	-38.594 (164.773)
Observations	1101	1101	1101

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility.

Figure 9: Effect of eligibility for pre-kindergarten on mothers' **employment** (Difference in Discontinuities)



**Notes:** SRD by academic year  $t/t+1$ . Linear estimation with 95% confidence interval. Years in the central part of the figure are those in which the PK rule was not applied. Robust standard errors are clustered at region level.



Table 10: Effect of eligibility for pre-kindergarten on mothers' labour market status by probability of receiving a job offer (Sharp Regression Discontinuity)

	Low lambda			High lambda		
	(1) 1st order polynomial	(2) 2nd order polynomial	(3) Local Linear Regression	(4) 1st order polynomial	(5) 2nd order polynomial	(6) Local Linear Regression
<b>Participation</b>						
ITT	0.065*** (0.018)	0.015 (0.030)	-0.016 (0.057)	0.051*** (0.010)	0.082* (0.046)	0.137*** (0.045)
Baseline	0.500	0.530	0.539	0.656	0.629	0.599
Observations	5300	5300	5300	5277	5277	5277
<b>Employment</b>						
ITT	0.041** (0.021)	-0.007 (0.031)	-0.016 (0.054)	0.057*** (0.017)	0.084* (0.050)	0.113** (0.048)
Baseline	0.434	0.472	0.463	0.606	0.587	0.568
Observations	5300	5300	5300	5277	5277	5277

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Table 11: Effect of eligibility for pre-kindergarten on mothers' labour market status by educational level (Sharp Regression Discontinuity)

	Compulsory school or less			High school			Higher education		
	(1) 1st order polynomial	(2) 2nd order polynomial	(3) Local Linear Regression	(4) 1st order polynomial	(5) 2nd order polynomial	(6) Local Linear Regression	(7) 1st order polynomial	(8) 2nd order polynomial	(9) Local Linear Regression
<b>Participation</b>									
ITT	0.031*** (0.002)	0.063*** (0.015)	0.090 (0.068)	0.085** (0.035)	0.061 (0.051)	0.110** (0.049)	0.060** (0.023)	-0.002 (0.051)	-0.055 (0.058)
Baseline	0.421	0.421	0.448	0.670	0.673	0.652	0.874	0.901	0.897
Observations	3489	3489	3489	4939	4939	4939	2149	2149	2149
<b>Employment</b>									
ITT	0.023 (0.025)	0.031* (0.016)	0.067 (0.057)	0.065* (0.038)	0.056 (0.043)	0.092* (0.051)	0.080*** (0.030)	0.017 (0.039)	-0.032 (0.065)
Baseline	0.310	0.308	0.268	0.559	0.561	0.547	0.764	0.824	0.817
Observations	3489	3489	3489	4939	4939	4939	2149	2149	2149

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Table 12: Effect of eligibility for pre-kindergarten on mothers' labour market status by marital status (Sharp Regression Discontinuity)

	Married			Single		
	(1)	(2)	(3)	(4)	(5)	(6)
	1st order polynomial	2nd order polynomial	Local Linear Regression	1st order polynomial	2nd order polynomial	Local Linear Regression
<b>Participation</b>						
ITT	0.067*** (0.006)	0.062*** (0.019)	0.073* (0.040)	-0.014 (0.023)	-0.015 (0.138)	0.026 (0.084)
Baseline	0.551	0.550	0.545	0.764	0.766	0.704
Observations	9095	9095	9095	1482	1482	1482
<b>Employment</b>						
ITT	0.059*** (0.000)	0.058*** (0.021)	0.068 (0.041)	-0.017 (0.019)	-0.048 (0.120)	-0.020 (0.073)
Baseline	0.497	0.501	0.491	0.683	0.710	0.657
Observations	9095	9095	9095	1482	1482	1482

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Table 13: Effect of eligibility to pre-kindergarten on mothers' labour market status by family income

	Low Family Income			High Family Income		
	(1) 1st order polynomial	(2) 2nd order polynomial	(3) Local Linear Regression	(4) 1st order polynomial	(5) 2nd order polynomial	(6) Local Linear Regression
<b><u>Participation</u></b>						
ITT	0.061** (0.029)	0.005 (0.054)	0.037 (0.049)	0.058*** (0.002)	0.101*** (0.036)	0.098** (0.049)
Baseline Observations	0.554 5331	0.592 5331	0.574 5331	0.605 5246	0.569 5246	0.562 5246
<b><u>Employment</u></b>						
ITT	0.042* (0.025)	0.000 (0.057)	0.012 (0.049)	0.060*** (0.002)	0.088** (0.036)	0.105* (0.058)
Baseline Observations	0.497 5331	0.536 5331	0.513 5331	0.546 5246	0.527 5246	0.516 5246
<b><u>Reservation wage</u></b>						
ITT	-38.712 (35.097)	42.372 (69.248)	-27.654 (117.795)	-121.890** (50.310)	-273.709*** (74.058)	-275.301** (120.700)
Baseline Observations	792.460 333	795.601 333	835.211 333	847.052 295	945.837 295	938.120 295

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Figure 10: Discontinuities in baseline covariates

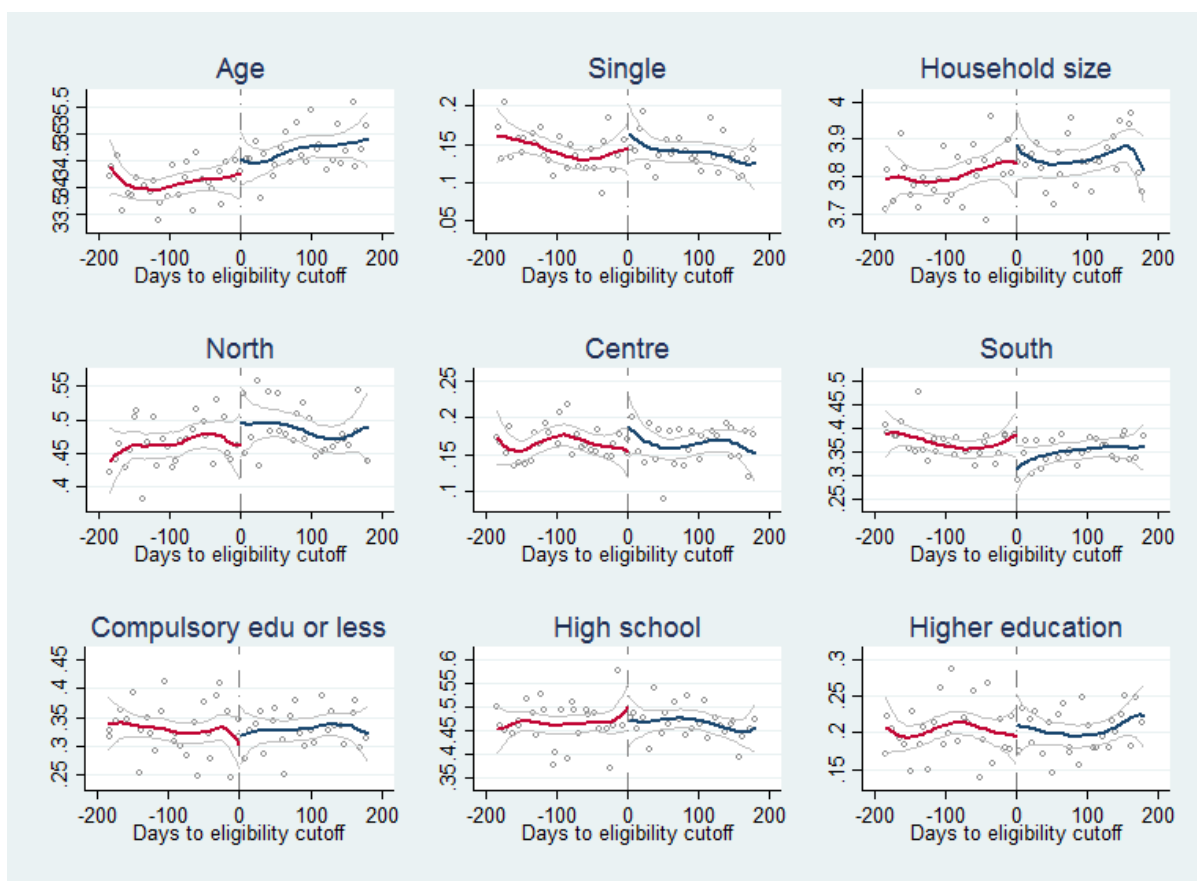
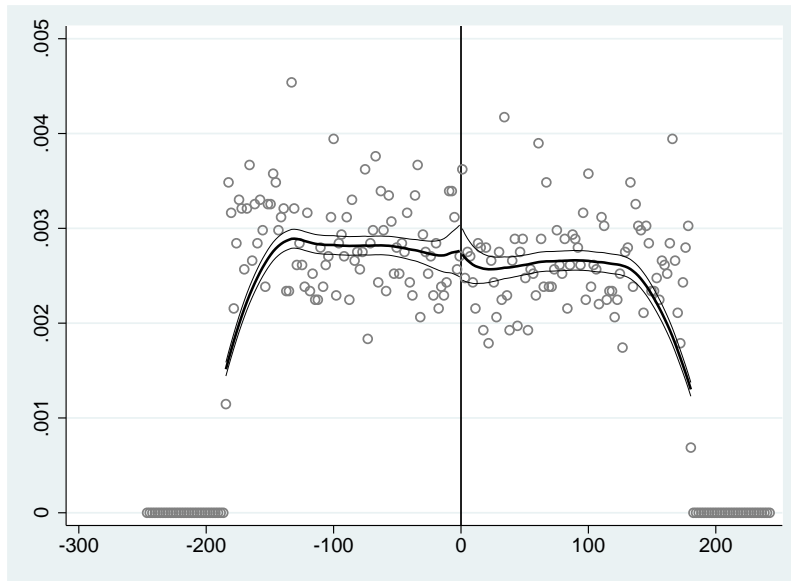


Table 14: Discontinuities in baseline covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Age	Single	Household Size	North	Centre	South	Compulsory Education or less	High School	Higher Education
ITT	0.063 (0.394)	0.007 (0.025)	0.013 (0.068)	0.047 (0.035)	0.019 (0.025)	-0.066* (0.035)	0.021 (0.031)	-0.028 (0.037)	0.007 (0.029)
Baseline		0.143	3.835	0.461	0.153	0.386	0.303	0.502	0.195
Observations	10577	10577	10577	10577	10577	10577	10577	10577	10577

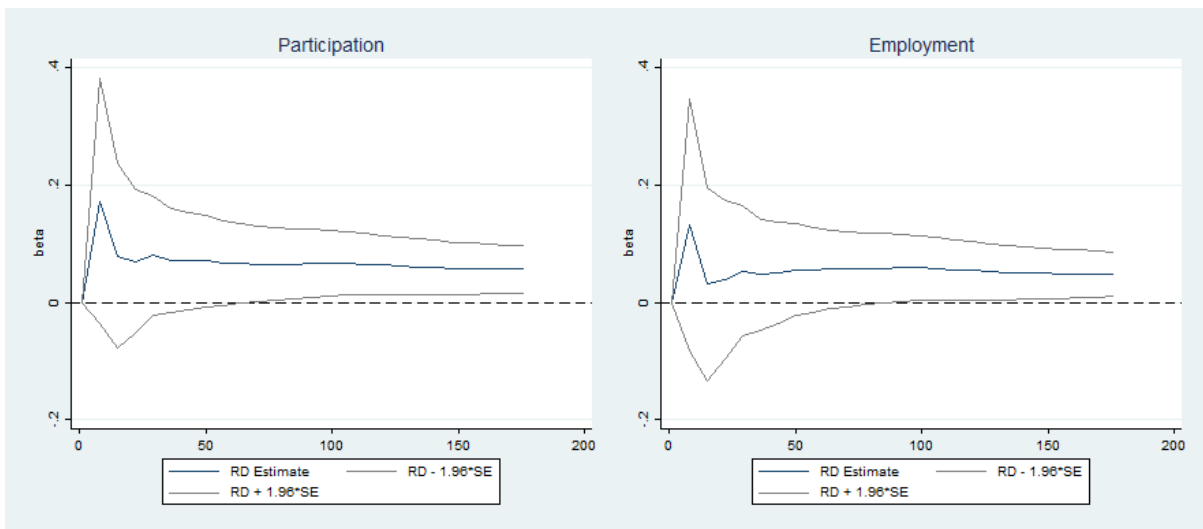
**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Figure 11: Test of manipulation of the running variable



**Notes:** McCrary test of manipulation of the running variable. Density distribution of sample on the two sides of the cut-off date.

Figure 12: Sensitivity to choice of bandwidth



**Notes:** Coefficients are obtained through Local Linear Regression with triangular Kernel and bandwidth of 60 days. Robust standard errors are clustered at region-year level and confidence interval is 95% level of significance.

Table 15: Falsification test: effect of eligibility to **kindergarten** on mothers' labour market status (Sharp Regression Discontinuity)

	(1)	(2)	(3)
	1st order polynomial	2nd order polynomial	Local Linear Regression
<b>Participation</b>			
ITT	-0.022 (0.018)	-0.05 (0.026)	0.002 (0.039)
Baseline	0.628	0.608	0.600
Observations	11069	11069	11069
<b>Employment</b>			
ITT	-0.017 (0.021)	0.015 (0.028)	0.006 (0.040)
Baseline	0.556	0.540	0.540
Observations	11069	11069	11069

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.

Table 16: Effect of eligibility to pre-kindergarten on fathers' labour market status (Sharp Regression Discontinuity)

	(1)	(2)	(3)
	1st order polynomial	2nd order polynomial	Local Linear Regression
<b>Participation</b>			
ITT	-0.010*** (0.002)	-0.005 (0.008)	-0.003 (0.012)
Baseline	0.977	0.974	0.975
Observations	10187	10187	10187
<b>Employment</b>			
ITT	-0.004 (0.008)	-0.011 (0.010)	-0.017 (0.016)
Baseline	0.936	0.937	0.943
Observations	10187	10187	10187

**Notes:** Robust standard errors clustered at region-year level in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. ITT is the estimated coefficient for Eligibility. The bandwidth used for non parametric estimation is 60 days. Baseline is the level of the outcome variable at the discontinuity for non-eligible individuals.