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ABSTRACT

Exploring the Impacts of Public Childcare on Mothers and Children in Italy: Does Rationing Play a Role?*

This paper investigates the effects of public childcare availability in Italy on mothers' working status and children's scholastic achievements. We use a newly available dataset containing individual standardized test scores of pupils attending second grade of primary school in 2008-09 in conjunction with data on public childcare availability. Public childcare coverage in Italy is scarce (12.7 percent versus the OECD average of 30 percent) and the service is "rationed": each municipality allocates the available slots according to eligibility criteria. We contribute to the existing literature taking into account rationing in public childcare access and the functioning of the childcare market. Our estimates indicate that childcare availability has positive and significant effects on both mothers' working status and children's language test scores. The effects are stronger when the degree of rationing is high and for low educated mothers and children living in lower income areas of the country.

JEL Classification: J13, D1, H75

Keywords: childcare, female employment, child cognitive outcomes

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1 Introduction

Advocates for public intervention in childcare provision offer two main arguments: 1) childcare providing children's "physical care" may support mothers' participation in the labour market and 2) childcare providing early childhood education may contribute to children's cognitive and non-cognitive development, especially for disadvantaged children, leading to gains in the accumulation of human capital in the society.

Existing research on the impact of childcare supply on maternal employment has been recently accompanied by growing interest in the impact of childcare on childhood development. Such studies suggest that children's cognitive and non-cognitive outcomes are largely determined early in life and that returns on investments in early childhood are higher than those on investments at later stages, especially for disadvantaged children (Carneiro and Heckman, 2003). Inputs from families as well as from the school system during early childhood play a very significant role in later cognitive, social, and behavioral outcomes (Heckman et al., 2006).

Childcare institutions are important arenas for children's development, and expanding childcare coverage is an explicit goal in many countries. In 2002, the European Union Presidency established the goal of providing "childcare by 2010 to at least 90 percent of children between 3 years old and the mandatory school age and at least 33 percent of children under 3 years of age" (EU, 2002).

Exploring the roles of public childcare is particularly relevant in Italy, where the labour market participation of mothers is much lower than in other European countries and children do less well in school than their European counterparts. In Italy, only 54 percent of mothers are employed, while this value is over 70 percent in the UK, France and Germany.[1] Furthermore, according to 2006 data from PISA (the Programme for International Student Assessment), 15-year-old Italian students rank fourth from the bottom in average educational performance among advanced countries (OECD, 2007).

Given the large number of children from single-child families, their main opportunities for early socialization may be those provided by childcare services and investments in childcare policies may also help alleviate intergenerational persistence, especially for children from low-income families. Instead, recent data (OECD, 2010) show that public investment in pre-school education in Italy is among the lowest in Europe.[2]

As a result, childcare is far less readily available than in other European countries: according to ISTAT (2010), only 12.7 percent of children aged 0-2 years in Italy have access to public childcare facilities and, despite the persistence of strong traditional values, which say that the child is better off in his/her mother's care, the demand for public childcare is still higher than supply in all Italian regions. When childcare applications outnumber supply, the municipal-

[1] Data from Eurostat referred to 2009.

[2] According to data from OECD Family Database for 2005, public expenditure on child care and early education services in Italy is equivalent to 0.6 percent of GDP, while this figure for France, Sweden and Denmark is higher than 1 percent (OECD, 2010).

ities, as the main decision makers in childcare policies, settle how to allocate the limited number of slots defining eligibility requirements according to their preferences. For example, childcare may be limited to children from low income families, to provide them educational opportunities and better inputs for their development than those received at home, or to those with working mothers, to support parents' conciliation between parenthood and work.

Our paper explores the role of public childcare in Italy, investigating its impact on mothers' working status and children's educational outcomes. We use a newly available dataset on children's primary school performance,in conjunction with data on public childcare coverage at the provincial level. Although the data do not allow us to analyze the determinants of parents' childcare demand, our main contribution to the existing literature on childcare's impacts would be to take into account rationing in public childcare access.

In the base specification, controlling for children's and parents' characteristics, we find that childcare availability is positively related to mothers' participation in the labour market as well as to language test scores. Once we account for rationing, we find that in areas where applications outnumber the slots available and where the probability of getting a slot depends more on eligibility criteria defined by the social planner, childcare has stronger effects. We explore also heterogenous effects and show that childcare's impacts are larger for children with lower educated mothers and living in lower income areas.

The rest of the paper is organized as follows. In Section 2 we review the existing literature concerning the impact of childcare on both mothers' participation and children's cognitive outcomes. In Section 3 we describe public childcare in Italy and its features, with particular attention to eligibility criteria and rationing; in Section 4, we present a theoretical model, representing the framework for our empirical analysis. In Section 5 we define the empirical strategy and the issues involved in the estimation, while Section 6 provides a description of the data and variables used. In Section 7 the empirical results are discussed: we first present empirical results from the base model (Section 7.1); then, we show results from the analysis by level of rationing (Section 7.2) and additional heterogenous effects (Section 7.3). Finally, Section 8 concludes.

2 The Literature

Several studies have analyzed the role of childcare as an important tool for reconciling work and family commitments during the childbearing years. Studies in the U.S. have mainly focused on programs for disadvantaged households and children.[3]

The empirical research analyzing the impact of childcare availability reports mixed findings. Havnes and Mogstad (2009a) analyze the impact of a change in childcare availability in Norway and find no significant effect on mothers' participation in the labour market, similarly to some studies for the U.S. (Cascio, 2009). Baker et al. (2008) evaluate the impact of public childcare programs in

[3]See Blau and Currie (2006) and Ruhm (2004) for excellent surveys.

Quebec (Canada), finding that the introduction of generous childcare subsidies led to a strong increase in employment for married mothers.

For Italy, Del Boca (2002), Del Boca and Vuri (2007) and Del Boca et al. (2009) find a positive impact of childcare coverage and childcare subsidies on the likelihood of mothers working. In particular, Del Boca and Vuri (2007) take into account the impact of rationing, due to childcare system rigidity (in terms of accessibility, opening time and costs), and find that in areas with higher childcare availability the probability of female employment increases.

In recent years, economic analyses have also focused on the impact of childcare on children's outcomes. In the economics literature on human capital, Becker (1964) has pointed out that the returns to investments in early childhood are likely to be relatively high, simply because of the long time in which to reap the rewards. Carneiro and Heckman (2003) took this argument further, arguing that investments in early childhood have higher returns for children living in disadvantaged contexts. Early childhood educational programs can generate learning gains in the short-run and, in many cases, improve the long-run prospects of children, especially from low-income families.

A number of studies for the U.S. show that the evidence regarding this impact is limited to short-run outcomes and that the findings are mixed. Loeb et al. (2007), for instance, find that pre-primary education in the U.S. is associated with improved reading and mathematics skills at primary school entry. Positive effects of childcare on children's short-run

outcomes are also found by Fitzpatrick (2008) but the impacts depend strongly on ethnicity and family income. Other studies (Magnuson et al., 2007) confirm these results, showing that the positive effects dissipate for most children already by the end of first grade, while larger and longer lasting associations with academic gains are found for disadvantaged children. Melhuish et al. (2008) suggest that children with low educated parents benefit most from childcare attendance.

Research from Europe focuses on public childcare, which is more widespread than in the U.S., especially in Northern countries. Datta Gupta and Simonsen (2010) evaluate the impact of childcare exposure at age 3 on children's cognitive outcomes at age 11, in Denmark. They find that having attended high-quality pre-school (instead of family day-care) has a positive impact on language and problem solving tests scores, while it decreases the probability of grade retention. Other studies use information on childcare coverage at aggregate level, as we do in this paper. Havnes and Mogstad (2009b and 2010) find that a substantial change in childcare supply in Norway has strong positive impacts on children's outcomes, although the impact is much stronger for children of low educated parents. Their results suggest a positive and significant impact of childcare coverage on educational outcomes, such as years of education and college attendance, but also on long-term outcomes, such as adult earnings. Felfe and Lalive (2010), instead, exploit a variation in childcare supply in Germany and find positive and significant effects on language skills in the short run and on school grades in the medium run.

In Italy, the topic of early child intervention, childcare impact and children's

outcome has largely been neglected. Only very recently there has been availability of data on children's outcomes (ISFOL, INVALSI and local data sources referring to specific areas, such as Emilia Romagna and Piedmont), which made it possible to consider the impact of childcare not only from the standpoint of physical care but also in terms of its role in educating young children. Del Boca and Pasqua (2010) compare different Italian data sources and show a positive correlation between childcare use and subsequent cognitive outcomes of children.

Finally, other related literature has investigated the functioning of the childcare market in Italy and the criteria used to allocate the limited slots to households (Bosi and Silvestri, 2008; Antonelli and Grembi, 2010).In our work we estimate the impacts of childcare availability on mother's working status and children's outcomes taking into account the role of rationing in public childcare access and the mechanisms implemented by the social planner to allocate available slots.

3 Childcare in Italy

While Italy is ranked quite high for its childcare policies for children aged 3-6, it fares much worse for its policies for children under three: public childcare for children aged 3 or older has a utilization rate of 95 percent, whereas public childcare for children younger than 3 is used by only 12.7 percent of children (ISTAT, 2010).

In Italy, childcare policy is decentralized: the municipality is the main decision-maker, while the regions define general management criteria;[4] the central government is only responsible for defining common objective standards and resources allocation among regions. This may explain why availability of public childcare for children under three varies greatly across regions, from around 25 per cent in some areas in the North to under 5 percent in most of the South (see Figure 1). Furthermore, in the last years, childcare supply from private providers has increased and developed differently across Italian regions (Istituto Degli Innocenti, 2002 and 2009). Public childcare differs from private childcare in several ways. For instance, public services are more strictly regulated both in terms of service standards and in terms of management and personnel requirements (Istituto Degli Innocenti, 2002) As recently stated in Budget Law 2002,[5] one of the most important aim of public childcare is educational. This goal has been implemented through the introduction of quality standards, especially in regions with greater experience in childcare provision (such as Emilia Romagna and Tuscany). Public childcare is also less expensive than the private one, since it is highly subsidized (Del Boca et al., 2005).

Although it is higher-quality and less expensive than either private childcare or baby-sitting services, public childcare is used by only a fraction of Italian

[4] To date, in Italy there are 8,092 municipalitiesin 101 provinces and 20 regions.

[5] Law 448/2001 (Budget Law 2002) defined formal childcare as "structures aimed at granting the development and socialization of girls and boys aged between 3 months and 3 years and to support families and parents with young children".

households. This is the outcome of both families' and municipalities' decisions. Families' decisions are often conditioned by persistent, strongly-rooted cultural norms. In Southern European countries, and Italy in particular, the traditional role of mothers is still highly valued and, hence, mothers are considered the best caregivers for their children.

Zollino (2008) uses data from ISTAT (Italian Survey on Births, ISB 2005) and the Bank of Italy (Survey on Household Income and Wealth, SHIW 2006) to analyze demand and supply factors of childcare services in Italy. Using both data sources, he estimates that all Italian households with children aged 0-2 may be classified in the following way: 58 percent of them did not apply since they prefer to care for their children on their own or to rely on informal childcare (grandparents, friends or relatives); nearly 18 percent of households report that were discouraged by the difficulties (distance, hours of services); 5 percent of households are explicitely rationed, meaning that they applied but did not obtain a slot; finally, only 19 percent of all applicants are actually assigned a slot. Furthermore, Zollino (2008) points out that data suggest a positive relationship between childcare coverage and the number of applications. In other words, the greater the supply of public childcare, the greater the parents' demand. This may also be associated to the level of trust people have in childcare institutions. Parents' trust may depend on the supply and quality of childcare, and on how long the systems have been in place. In fact, in regions with a longer tradition of childcare (such as Emilia Romagna) not only is the supply of childcare higher (in terms of the number of slots) but so is the demand (in terms of the number of applicants).

As Figure 2 shows, the demand for childcare is higher than the supply everywhere in Italy. In regions where public childcare is established for longer time and more widespread, the number of applications is greater. Northern regions have a large number of applicants and a higher number of slots, whereas Southern regions have fewer slots and lower demand.

On the supply side, the municipalities' decisions concerning the number of childcare slots to offer depend on their preferences, as to which types of household to target, and on their budget constraints. Each municipality establishes eligibility requirements so that the number of available slots can be assigned to households who benefit more.[6] While absolute priority is given to applications of children with disability,the other criteria can be classified into two main categories. The first category include mainly the following eligibility criteria: having both parents working (part-time or full-time), having parents with turns at work or commuting, having other siblings (an higher score is given if siblings are aged 0-3). The second category includes mostly criteria related to the socioeconomic conditions of the household, such as being orphan or fostered child, having one or both parents unemployed, living with single parent.[7]

[6] Bosi and Silvestri (2008) argue that the municipality has imperfect information about the real demand of childcare, so that eligibility criteria can help the social planner in identifying those parents really interested in the service among all potential demanders. In this context, access criteria might be viewed also as a *screening device* used by the social planner.

[7] There may be a third category, including criteria not related to specific social planner's

Thus, according to these access criteria, public childcare can be viewed both as a tool to help families to reconcile work and parenthood during the childbearing years, and as a social service aimed to support the early education and the social inclusion of children from low income families and stressful environments.[8]. From the social planner's point of view, both outcomes are particularly important for Italy. On one hand, in fact, nearly 30 percent of mothers leave their jobs after the birth of the first child and the probability of leaving the labor market after childbirth is higher for low educated mothers and in areas with limited childcare (Bratti et al., 2005; Pronzato, 2009). On the other hand among low income households eligible for childcare, a growing number of children are from immigrant families implying the importance of institutions favouring their social integration (Dalla Zuanna et al., 2011).

4 Theoretical Framework

In this section, we present a framework that helps interpret our econometric models and results.The municipalities' decisions regarding the supply of childcare slots depends on the local budget constraint and preferences of the local government. We assume that local governments aim to encourage women's work (which would also increase the tax base that can be used to pay for local services, including childcare) and to increase the educational outcomes of children through public childcare.

The objective of the municipality is given by

$$U(L, E)$$

where L is the participation of mothers (of young children) and E is an indicator of the educational outcomes of children in the local area. The social planner seeks to maximize her objective by manipulating (final) demand, which is accomplished by using the policy variables at disposal. We assume that the policy variables are: N, the number of public childcare slots; P, the price charged each households for a slot; and R, the rules used to assign slots to potential demanders in the case of excess demand at the price P. In this simple model, we assume that the price P is the same for all households. Given the population of potential demanders (mothers with young children), there exists a set of households that would gain access to public childcare under (N, R, P). In this set of households, we say that the number $L^*(N, R, P)$ would work and that the educational outcome of all children is given by $E^*(N, R, P)$. Hence, the social planner solves the following maximization problem:

objectives but often used as a priority criteria when candidates have equal scores: for example, being in the waiting list or attending the facility the previous year, income or the availability of grandparents.

[8] According to Antonelli and Grembi (2010), who collected information on accessibility criteria adopted in a sample 144 Italian municipalities, the second criteria seem to prevail, that is support the early education and social inclusion of children from disadvantaged backgrounds

$$\max_{N,R,P} U(L^*(N,R,P), E^*(N,R,P))$$

We now consider the constraints on the social planner's choices. A social planner may use rationing as a means to maximize her objective function. For example, if the social planner wants to increase maternal employment, she could do so by limiting access and making maternal employment one of the criteria for acquiring a slot. Different rationing criteria may be utilized if the social planner wants to increase the educational outcomes of children in this population. Viewed in this way, rationing and selective access are outcomes of a mechanism design implemented by the social planner. The monetary constraint the social planner faces is given by

$$C \times N = S + P \times N$$

where C is the cost of each childcare slot sustained by the municipality; S are the fixed subsidies that the central government has allocated to the local government; and P, the price per slot. Hence, the number of slots the social planner can provide given S and P is

$$N = S/(C - P).$$

As the social planner increases the price (P), the number of slots increases. We assume that for any N, potential demand is such that there exists a $P^*(N)$ allowing demand to exactly equal supply (N) at that price. In this case, the price serves to "ration" demand, and the rules R are irrelevant: only households with a willingness to pay for childcare greater than or equal to P^* would get a slot. This implies that, in such cases, only households with higher income or those highly valuing childcare would be able to pay for this service.

Thus, at any P less than $P^*(N)$, there will be excess demand and the rationing rules become operative, selecting potential demanders whose characteristics and choices the social planner values. By lowering the price and creating excess demand, the social planner can choose individuals who acquire the slots instead of having the "market" to do this strictly through the price mechanism. However, there is a cost to this selection, in that fewer slots can be generated. At $P = 0$, the municipality can choose perfectly how to allocate the slots to households which are eligible according to the allocation criteria R. But, in this case, the supply of slots may be very low given that S will be the only source of program revenue.

We now consider the demand side. The probability of childcare use depends on mothers' wages, non-labor income, preferences, and childcare price P. Mothers know only P and do not know R. Even if they do know the rationing criteria, since they are assumed not to know who else may be applying for a slot, they cannot assess the likelihood of getting a slot should they apply. Since we assume that the application cost is minimal, anyone with a demand for childcare at price P in the absence of rationing will apply.

In our framework, we assume that mothers care about consumption (including expenditure for children), leisure and children's educational quality. Since

a mother's working status and childcare use are strongly related, we posit that they have a choice set containing four elements and that, within each choice, the mother chooses an optimal amount of time, τ, to spend with the children. In the following table, we define the mother's value of each work-childcare use combination.

WORK	CHILDCARE USE	VALUE
0	0	$\max_\tau M(Y, T-\tau, \theta\tau)$
1	0	$\max_\tau M(Y+W, T-\tau-h^*, \theta\tau)$
0	1	$\max_\tau M(Y-P, T-\tau, \theta\tau+\zeta h^*)$
1	1	$\max_\tau M(Y+W-P, T-\tau-h^*, \theta\tau+\zeta h^*)$,

where Y is non-labor income, W is the mother's wage, T is the total time endowment of the mother, θ is the mother's (educational) productivity of time with her child and ζ is the (educational) productivity of childcare time. The time at work of a working mother is h^*, which is also the amount of time the child spends in public childcare (even for mothers using childcare who do not work). In this framework, we allow mothers to use childcare, even if they do not work.

According to the four categories defined above, only the third and the fourth would explicitly apply for childcare. In case of an excess demand of childcare, slots have to be rationed so as to maximize the social planner's preferences. Following the eligibility criteria, the social planner evaluates their applications. They would be able to get a slot only in case their characteristics match the social planner's requirements. If the social planner values more conciliation criteria (see Section 3), she would give priority to children with working mothers (the fourth category in our model). Instead, if the social planner values more the criteria related to socio-economic status, she would give priority to children coming from disadvantaged backgrounds: these children would receive better educational inputs attending public childcare than at home. In our model, these children might refer to the third category of women. In fact, we argue that the mother may not choose childcare evaluating her own "educational productivity" with respect to childcare's educational productivity. Instead, the social planner may decide allocation mechanisms in order to identify those households where family investments in child education may be insufficient (for example, due to market failures, such as asymmetric information or liquidity constraints). As pointed out in Bosi and Silvestri (2008), parents might be myopic in their childcare choices, as they do not thoroughly evaluate the educational role of childcare. Instead, the social planner might value the benefit given by childcare in terms of human capital accumulation and development of children. In the model above, women belonging to the third category would be able to get a slot if the social planner values their "educational productivity" to be lower than that of childcare, i.e., $\theta \leq \zeta$.

Even though eligibility requirements may be different across local areas, producing mixed types of eligible households, we expect that when childcare coverage is rationed, it has a stronger impact on mothers' working status and on children's educational outcomes, since it selects groups which are more likely

to benefit from the services.

5 Estimation Methods

We think of the value of working for mother i in province p to be a function of her and the father's characteristics, H_{ip}, and the child's characteristics, X_{ip}. For example, H_{ip} includes the mother's educational level, which will partially determine the wage offers she receives in the market and may also indicate her "tastes" for work. There are of course other unmeasured characteristics of the household and child that are important determinants of the mother's labor market participation decision, which are reflected in the disturbance term ε_{ip}.

We also include the number of public childcare slots available in the province in the equation, N_p. Our rationale for doing so is the following. One determinant of the mother's willingness to supply time to the labor market is the price of child care. If we view the public child care market as being approximately "competitive," then the supply of childcare slots would equal the demand at the equilibrium price P. Now imagine that the demand for childcare services was approximately the same across all provinces, but that provinces were differentiated in the cost of supplying childcare slots. Then the (equilibrium) number of childcare slots in province p, N_p, would be inversely related to the price of childcare in the province, P_p. Since we do not observe the price, we use N_p as an indicator of it in our baseline "competitive markets" model.

We construct an equation for the determination of child i in province $p's$ cognitive ability scores, E_{ip}. These outcomes are functions of household parental and child characteristics, as in the previous case, as well as a disturbance term. We do not know if a particular child actually attended childcare, so the variable N_p is an indicator of the likelihood that she or he did (since it reflects the price of child care in the area). If N_p is inversely related to the price of childcare, thus making the use of it more likely, and if attending public childcare is beneficial in terms of cognitive development, we expect to see a positive relationship between N_p and child test scores under our competitive view of childcare provision.

Thus the system we estimate has the form:

$$L_{ip} = X'_{ip}\alpha_1 + H'_{ip}\alpha_2 + \alpha_3 N_p + \varepsilon_{ip} \tag{1}$$

$$E_{ip} = X'_{ip}\delta_1 + H'_{ip}\delta_2 + \delta_3 N_p + \omega_{ip} \tag{2}$$

where L_{ip} is a binary variable equal to 1 if the mother of child i in province p works (when the child is enrolled in second grade) and E_{ip} is child i's cognitive outcome, proxied by child i's scores in language and math tests. X_{ip} and H_{ip} are vectors of children's and parents' characteristics. The variable N_p represents public childcare coverage at the level of the province (which is as we discussed above we interpret as a proxy for price, conditional on demand)[9] The properties

[9] The provincial level is the lowest for which we can obtain data on public childcare supply. Even though the main policy maker in childcare provision is the municipality (see Section

of the disturbance terms, ε_{ip} and ω_{ip}, are discussed below.

We now consider how rationing impacts L_{ip} and E_{ip}. In practice, under rationing, both the likelihood of obtaining a childcare slot and, given the offer of a slot, the actual cost of it to the parents is potentially a function of household and child characteristics. It may be helpful to think of this situation reflecting nonlinear prices for childcare slots. In a regime with rationing and assignment of slots based on household characteristics, both the tota

l number of slots in the province and household characteristics determine the price of childcare, and hence the likelihood that it is utilized. In this case, the impact of parental characteristics, for example, on the labor market participation behavior of mothers will reflect both the effects of these characteristics that we expect to observe in the competitive childcare market case and, in addition, the impacts of these characteristics on the price of childcare. Our empirical strategy is to define an indicator variable, d_p, which assumes the value 1 if household i lives in a province p with a high degree of rationing and equals 0 when this is not the case. As we will describe in Section 6, for each province p we compute a measure of rationing R_p,defined as the ratio of applications to available slots. Then we will say that province p has a high degree of rationing if $R_p \geq \bar{R}$, in which case $d_p = 1$. We reestimate the model with various values of $\bar{R}$ to determine the sensitivity of our results to this essentially arbitrary choice.

We perform a test to determine if rationing significantly alters the relationship between household and child characteristics and outcomes, in the standard way. In particular, define

$$\begin{aligned} L_{ip} &= X'_{ip}\alpha_1 + H'_{ip}\alpha_2 + \alpha_3 N_p + d_p X'_{ip}\alpha_4 + d_p H'_{ip}\alpha_5 + \alpha_6 d_p N_p + \varepsilon_{ip} \quad (3) \\ E_{ip} &= X'_{ip}\delta_1 + H'_{ip}\delta_2 + \delta_3 N_p + d_p X'_{ip}\delta_4 + d_p H'_{ip}\delta_5 + \delta_6 d_p N_p + \omega_{ip} \quad (4) \end{aligned}$$

Then rationing does not have a statistically significant impact on these outcome measures when

$$\begin{aligned} \alpha_4 &= \alpha_5 = \alpha_6 = 0 \\ \delta_4 &= \delta_5 = \delta_6 = 0. \end{aligned}$$

We now consider the properties of the disturbance terms, which we will have to know to carry out the hypothesis test just described. The disturbances ε_{ip} and ω_{ip} are composite error terms that are defined as follows:

$$\varepsilon_{ip} = \alpha_p + \epsilon_{ip} \quad (5)$$

$$\omega_{ip} = \delta_p + \upsilon_{ip}, \quad (6)$$

where α_p and δ_p are province-specific components, assumed to be normally distributed, while ϵ_{ip} and υ_{ip} stand for disturbance errors at individual level.

3), we may reasonably assume that policies for very young children (such as childcare) are homogeneous within the same province.

In order to take into account the error components at provincial level, we estimate the above equation using GLS (or Random Effects -RE) model. Moreover, since we are using mixed-level data, including information at the individual and provincial levels, it is likely that observations in the same province are not independent, so standard regression techniques attribute too large levels of statistical significance to coefficient estimates (Moulton, 1990). Thus, following Primo et al. (2007), we adopt cluster-adjustments of the estimates of the standard errors to account for non-independence of observations within the same province.[10]

The coefficients of interest are α_3 in Equation (1) and δ_3 in Equation (2) in the base specification. Using the aggregate number of slots available in the local area (the province) allows us to claim that there is little scope for endogeneity between the childcare measure and the composite disturbance term in any of the individual-level outcome equations. In fact, using information on childcare coverage at provincial level avoids the usual problem of selection and sorting of children and parents in individual childcare attendance. However, we need to discuss some issues related to the assumptions implied by the model.

The first consideration refers to the orthogonality assumption and to the absence of correlation between the province components, α_p and δ_p, and the included regressors. Actually, the availability of public childcare may be correlated with some province's characteristics that may affect mothers' participation in the labor market or children's cognitive outcomes. Consider first the participation equation (Equation (1)). It would be the case that provinces more oriented to gender-equality are also more developed in terms of work opportunities for women and of policies for reconciling work and family committments (such as childcare). The correlation between childcare coverage and these provincial characteristics may lead to overestimate the true childcare impact on the participation of mothers with young children. In the absence of longitudinal data, which would allow us to condition on unobserved province fixed effects, we cannot estimate the direct impact of child care slots and rationing (purged of these other confounding effects) in a flexible manner. Our second best option is to include province-level regressors that reflect provincial resources. The only such variable directly available to us is GDP *per capita*. Now consider equation (2) for test scores. In this case, public childcare supply may be correlated with higher public expenditure in education and better school systems that allow children to get better results at school. The correlation between childcare coverage and high-quality public education may lead us to overestimate the true childcare effect. As in Equation (1), we condition on GDP per capita in order to take into account different public expenditure for education among provinces.

Second, we should consider the potential measurement error in the childcare variable, N_p. In fact, information on public childcare coverage at province level is available only for 2005, while children enrolled in second grade in 2008-09 would have been aged 2 years in 2002-2003.[11]. Our childcare measure is po-

[10] We adjust standard errors for 100 clusters, i.e. the number of provinces in our sample.
[11] See Section 6 for further descriptions of data on public childcare coverage.

tentially different from the "true" childcare availability faced by the households in our sample. This measurement error, i.e. the difference between observed childcare coverage in 2005 and the "true" (*unobserved*) childcare coverage in 2002, is incorporated in the province-specific error components α_p and δ_p. In order to get consistent estimates from Equations (1) and (2), we need to define measurement error as having zero mean and being uncorrelated with the observed measure of childcare. We need to assume that the difference in childcare supply between 2002 and 2005 is uncorrelated with other unobservable characteristics, at province level, which affect the outcomes of interest.[12] Recent reports on childcare provision in Italy (Istituto Degli Innocenti, 2009) confirm that childcare growth has been very limited in this period. In other words, although uncorrectly measured, we may argue that childcare coverage in 2005 can be considered a good proxy for childcare coverage in 2002.

The third consideration refers to the interpretation of our coefficients estimates. Consider first the participation equation. In Equation (1), we estimate the effect of childcare coverage when the child is very young on mother's working status when the child is enrolled in second grade (aged 7 years, if regular in his/her school path). Actually, we do not know information on mothers' work history neither on mothers' employment status before and after childbirth. This information would allow us to control for some mother's *unobservables* that may influence her decision to work and to better understand the mechanisms deriving from additional public childcare slots. Due to the limitations and the cross-sectional nature of our data, we can only interpret the parameter of interest in Equation (1), α_3, as an average effect. Given the level of childcare available, mothers may behave (in terms of employment decisions after childbirth) in different ways. While some of them would have interrupted employment after childbirth, regardless of childcare availability, others may have had the opportunity to go back to work even if childcare were not available. Only those "at the margin" would have benefited from childcare availability, in the sense that the additional childcare slot may have increased their probability to continue working. Recent studies show that in Italy female employment is a very "persistent" phenomenon in women's life cycle and that work interruption after childbirth crucially affects women's career and their future employment (Bratti et al., 2005; Del Boca and Sauer, 2009). Thus, we may argue that childcare availability might play a role for women working before childbirth, because it may weaken the negative trend of female employment after childbirth. Instead, childcare might have no or very low effect for women not working before childbirth. Since our data do not allow to disentangle these effects, the coefficient for childcare coverage would represent an average between these heterogeneous impacts.[13] Consider now Equation (2). Also in this case, our childcare variable refers to the average childcare supply at provincial level and we do not

[12] This assumption implies that measurement error is only correlated with the *unobserved* measure of childcare coverage, i.e. childcare coverage in 2002.

[13] However, women heterogeneity may not affect our estimates of childcare coverage impacts as long as it is captured by the individual error component, ϵ_{ip} and it is homogeneous within the same province.

know whether a child was enrolled in childcare or not. Thus, the parameter δ_3 identifies the full effect of a change in childcare coverage on children's cognitive outcomes in second grade: it captures the total effect of childcare "exposure", including any effects due to change in public childcare arrangements as well as any spillover effects on children who were not attending childcare.

Finally, we should take into account that the component of the disturbance terms ϵ_{ip} and v_{ip} may include *unobservables* of both mothers and children (e.g. ability). A mother's ability is very likely to be correlated with her education and with her employment decisions; moreover, a child's ability can be correlated with his/her parental background, included in the model through mother's and father's education, H_{ip}. Therefore, we cannot claim a causal impact of any of the parents' variables in both equations.

6 Data and Variables

We use individual data on children's primary school outcomes in conjunction with information regarding public childcare coverage at the provincial level.

Data on children's cognitive outcomes are taken from the Italian Institute for the Evaluation of the Education System (INVALSI) for 2008-2009. INVALSI and its National Evaluation Service (SNV) provide the only ongoing national survey of students' educational achievements at primary school. These assessments measure the abilities of students in second and fifth grades (ISCED level 1), normally aged 7 and 10 years [14]

In addition to test scores, INVALSI provides information on the children's and parents' characteristics reported by the schools. Thus, the data include individual-level covariates indicating gender, citizenship, parents' working status and education. However, missing information on family characteristics represents over 30 percent of observations and missing data on the children's personal characteristics are almost 11 percent. Even though missing data may not be systematically linked with our analysis, we find that immigrant children, on which school administrations may not have records, are more likely to have personal and/or family missing information.[15] Thus, we have decided not to drop them and to include dummy variables indicating whether family or child information is missing.

For our analysis, we rely on data concerning second grade students in the school year 2008-09. Our final sample consists of all second graders who took both language and math tests. Thus, at the end we have 43,073 observations in test scores regressions, while in the estimation of Equation (1) we keep only observations without family information missing and we end up with 27,673 observations.

[14] See Appendix A for details on INVALSI data and on the design and implementation of INVALSI assessments.

[15] In order to deeply analyze this point, we perform probit regressions using as dependent variables dummies indicating whether child or family information is missing. Results are available upon request from the authors.

In conjunction with with our sample of children attending second grade in 2008-2009 the most appropriate measure of childcare coverage would be in 2002-2003 (when the children in our sample were 2 years old). However data on public childcare coverage at provincial level are available only for 2005. As pointed out in Section 5, the growth of childcare during this period has been very limited so the actual numbers did not change significantly in the two years.

Childcare coverage is defined as the percentage ratio between public childcare slots and the population aged 0-2 years, by province. Data are taken from *Cittadinanzattiva* (Cittadinanzattiva, 2007), an independent organization that has been running a yearly survey to monitor supply and prices of public facilities, including childcare services.

In order to take into account the role of rationing, we use data on childcare applications and the number of available slots in the main municipality of each province, that can be found in Cittadinanzattiva (2007). Using these data, we construct an indicator of rationing, defined as the ratio between the number of applications filed and the number of accepted applications (i.e., the available slots). This index,in our sample, is never less than one: the greater its value, the more severe is rationing.

Table 1 gives the definition of each variable, while Table 2 provides some descriptive statistics.

In this analysis, we consider three dependent variables. The first, *mother's working status*, is a dummy equal to one if the child's mother works and equal to zero otherwise. As we can see from Table 2, almost 62 percent of children in our sample have mothers participating in the labor market. The average partecipation rate of mothers in Italy is lower (56 percent) than the average in our sample. However, if we consider only mothers aged 25-54 with children between 6 and 11 years old, the average partecipation rate is 61 per cent,[16] that is closer to the value we find for our sample.

The other two dependent variables refer to children scholastic achievements. They represent children's scores in language and mathematics tests provided by INVALSI. Since these tests are composed by multiple-choices questions, the final test score is built as percentage of correct answers over the total number of questions. As shown in Table 2, children perform better in language than in math, being the average test score in language 66.2, while average test score in math is only 55.5; the distribution of language test scores is more right-skewed than that of mathematics.

The second panel of Table 1 defines the variables on childcare availability. The main variable of interest is childcare coverage at province level. Public childcare coverage is, on average, only 8.07, and the median childcare availability is equal to 6.77. Childcare is also highly differentiated across Italian provinces, ranging from values close to 0 in some Southern Italian areas to more than 24 percent in some Northern Italian areas. The index of rationing, on average, is equal to 1.68 and ranges from 1 to 3.94, implying that Italian provinces differ also in terms of likelihood to get a slot.

[16] Data from Eurostat referred to 2009.

The third panel of Table 1 defines personal, household and environmental characteristics used as regressors in the analysis. In our analysis, we control only for child's gender and citizenship[17], together with parents' level of education and GDP *per capita* by province.[18]

As described in Table 2, fifty percent of the children are male, and only 4 percent are immigrants.[19] This percentage is lower than the corresponding one of the entire population, since the total percentage of non-Italian students in second grade is about 8 percent (MIUR, 2009). Mothers are more likely to have tertiary education than fathers: 16 per cent versus 14 percent of fathers. Finally, for 36 percent of our initial sample we do not have information on parents' education or mother occupation, while for 11 percent of children we lack information on gender or citizenship. These descriptive statistics confirm that missing data are a problematic issue here. GDP, on average, is equal to 23.15 thousands Euros, and ranges from 12 to 36 thousands of Euros.

Figures 3 and 4 report the correlations between childcare coverage and the outcomes of interest at the regional level. Regions with higher childcare coverage are characterized by higher mothers' employment rate and better results in language test scores: correlation coefficients between childcare coverage and both mother's working status and average language test score are positive and significant while are not significant for math.

7 Empirical Results

In this section, we present the empirical results based on equations (1) and (2). First, we report the results from the base model. Then, in order to test the hypothesis that childcare impacts would be different under rationing, we perform the same analysis on different subsamples characterized by different levels of rationing. The results are presented in Section 7.2. Finally, we investigate whether childcare coverage may have heterogeneous effects, exploring the potential role of different accessibility criteria adopted by the social planner. In Section 7.3 we present the results for heterogenous effects.

[17] We do not control for child's age. Actually, INVALSI provides only information on child's year of birth or regularity in his school path (whether retained or enrolled in higher grade with respect to his age). However, child's age may affect our estimates, especially because childcare coverage in 2005 may differ from the true childcare coverage faced by children with different ages. In order to test this point, we replicate the analysis considering only children regular in their school path (37,421 observations) and results do not differ from the ones presented in Section 7. Results are available upon requests from the authors.

[18] Data on GDP *per capita* by province are taken from *Camera di Commercio*, Statistical Service, and refer to gross domestic product in 2008.

[19] Children without Italian citizenship include both children born abroad and children born in Italy with both parents of foreign origin. Italian law is based on the principle of jus sanguinis: children of foreign parents are foreign citizens up to their 18th birthday, then they may apply for Italian citizenship.

7.1 Base Model

In this section we discuss the results of the estimation of equation 1 and 2. When estimating the first equation in which mother's working status is the dependent variable, we only keep observations without missing data on family characteristics, which reduces our sample to 27,673 observations. In Table 3 we compare the mean characteristics in the different samples used for the estimation which show that most variables are not statistically different across samples.

Table 4 reports the coefficients of the independent variables on mother's working status. The coefficient of childcare coverage is positive and significant: an additional 10 percentage points in childcare coverage increase the mother's probability of working by 13 percentage points. As discussed above mother's working status is observed when the child is enrolled in second grade. Even in provinces where childcare 0-2 is scarce, a number of mothers have had the opportunity to go back to work, when their children were enrolled in childcare 3-5 or in primary school. So differences in mothers'employment rate across provinces are mitigated by the fact that mothers are observed when children have access to pre-primary and primary school, which are more homogenouosly distributed across provinces.The fact that we still find a positive impact of childcare coverage on mother's work means that care opportunities provided by childcare services play a crucial role in helping mothers to keep their job after childbirth. Thus, childcare availability may weaken the negative relationship between mother's employment and fertility and decrease the likelihood of work interruption after the birth of a child.

Child's gender is not significantly associated with mother's working status, while immigrant status does matter: mothers of non-Italian children are less likely to work than those of Italian children; the coefficient for being non-Italian is negative and significant. Mothers' working status, as expected, is strongly and significantly associated with her education, confirming previous results in this strand of the literature, especially for Italy (Del Boca et al., 2009). The same is true for the father's education: mothers married to highly educated partners are more likely to work, indicating "assortative mating" between partners. We add as controls variables child missing information which is statistically equal to zero and GDP by province, which is positively and significantly correlated with mother's working status.

In the second and third columns of Table 4 we report the coefficients on language and math test scores Childcare coverage affects positively language test score, while its impact on math test score is not significantly different from zero. A 10 percentage points increase in childcare avalability is associated with an increase of 1.8 points in language test scores. In fact, cognitive skills used in the language test may benefit more from socialization and from other activities taken up at childcare facilities; instead, math skills seem more linked to innate abilities and may benefit less from the interactions with other children in the first years of life. Our result is consistent with previous findings (Felfe and Lavine, 2010), showing that local availability of childcare has a positive impact on the short run development only of language skills. Since we do not

have information on individual childcare attendance, we interpret this result as the effect of childcare coverage on children's outcomes, including potential externalities and spillover effects

We find a positive and significant impact of both paternal and maternal education on children's test scores. The effect of parental schooling on children's outcomes may work through different channels: more educated parents have, on average, higher income, and can purchase more (or higher quality) goods for their children; they may have stronger preferences for investing in education, and spend time with children doing homework. On the other hand, more educated parents have higher opportunity cost from not-working, potentially limiting the amount of time they spend with their children. Finally, the correlation between parental and children's education could just be due to the transmission of genes. Recent literature focusing on the intergenerational transmission of schooling (Pronzato, 2010; Holmlund et al, 2010) has shown a positive impact of both parents even when controlling for the unobserved ability transmitted by the parents to the children.However, they show that these causal effects are much lower than the spurious effects obtained by not taking into account unobserved ability. In our empirical work, we find that the coefficients are greater for language than for math, but they do not differ between parents.

Gender coefficients are quite different across subjects: boys achieve, on average, higher test scores in mathematics and lower test scores in language than girls. This result is coherent with the comparative analysis of Guiso et al. (2008) which report that girls perform more poorly than boys in mathematics but better than boys in reading. Their cross-country analysis show that the girls' underperformance in math relative to boys is better in countries which exhibit more gender equality.

Non-Italian children perform worse than their Italian peers and, as expected, test score gaps are higher for language than for mathematics. Finally, coefficients for child missing information are never statistically significant, while having missing family information is always significant in test scores regressions. GDP is positively and significantly correlated with both language and math test scores.

7.2 Rationing in public childcare access

We now use several thresholds of rationing for identifying subsamples with different levels of rationing. We expect that, other things being equal, the higher the rationing the higher the probability that getting a slot depends on eligibility criteria. If the service is highly rationed, access criteria will become more stringent, and the smaller number of children/households targeted is expected to be more responsive to childcare coverage. To interpret the results we need to keep in mind that in each sub-sample, we are comparing outcomes in provinces with different childcare availability but with a similar strength of rationing (in the same interval). Suppose we have two provinces: in province A a proportion D_A of households applies for a childcare slot, while in province B the proportion of applicants is given by $D_A * k = D_B$. We may expect the two populations

of applicants to be quite similar (for example, for women's willingness to work) even if different in size (whose relationship is given by k). Suppose the number of slots available is half in both cases, leading to the same level of rationing: province B would still have higher availability than province A. In fact, childcare coverage is $N_A = D_A/2$ in province A and $N_B = (D_A * k)/2$ in province B. In province B more households "at the margin" will receive the treatment compared to province A, justifying the positive and significant effects of childcare coverage on the outcomes of interest.[20]

We re-estimate the base model with the independent variables interacted with $d_p = 1$,indicating various values of $\bar{R}$ to determine the sensitivity of our results . We define high degree of rationing if $\bar{R}$ is greater than -respectively-the first quartile, the median, and the third quartile

Tables 5 and 6 report the results for mother's working status and children's test scores based on the estimation of equation 3 and equation 4. In both specifications, we interact childcare coverage as well as other variables which are potential indicators for eligibility criteria (mother, father education and child non italian) with different rationing levels.

Childcare coverage coefficients are always positive and significant in mother's working status regressions, and the impact is stronger for high level of rationing. A 10 percentage increase in childcare supply induces a percentage increase in the mothers' probability of working ranging from 16, when the threshold is low, to 19 when the threshold is high.

Table 6 reports the coefficients of the regressions with language and math test scores as dependent variables. The childcare coverage coefficients are always positive and significant on language test score. Only in areas with high rationing, the coefficient of childcare is positive and significant not only for language but also for math.These results support the notion that households "at the margin" in high rationing areas are more responsive to changes in childcare availability.

We then perform F tests in order to determine if rationing significantly alters the relationship between a set of household chracteristics, child care and outcomes.Our results shows that rationing have a statistically significant impact on these outcome measures (Table 7). The null hypothesis:

$$\begin{aligned} \alpha_4 &= \alpha_5 = \alpha_6 = 0 \\ \delta_4 &= \delta_5 = \delta_6 = 0. \end{aligned}$$

is then rejected for mother working status in low rationing, while for children test scores only in high rationing. It is possible to interpret this difference using the framework described above. It is possible that when the availability

[20] Felfe and Lavine (2010) find that in areas with high childcare availability the impact is larger than in areas with low childcare availability. They argue that when childcare supply is low mainly highly educated and highly motivated parents are actively engaged in application for childcare and that slots allocation follows a "first come, first served" mechanism, so that only children with highly educated parents are actually enrolled. However, they may benefit less from childcare attendance than children from disadvantaged background. Instead, in our case, selection of applicants is implemented by the social planner who targets households and children that may benefit more from the policy.

of slots are large enough relatively to demand, the social planner may give priority to women working, while when the availability of slots becomes relatively scarce,may give priority to disadvantaged children.

Due to the limitations of our data, however, we cannot say much about the decision-making process of the social planner. In other words, since we do have information on the eligibility criteria adopted by each municipality, we are not able to disentangle the effect of rationing. In order to explore the potentially different childcare impacts according to accessibility criteria, we replicate the analysis for different subsamples, identified by mother's level of education and wealth of the province.

7.3 Heterogenous effects

As pointed out in Section 3, accessibility criteria differ across municipalities and each municipality may value households' characteristics in a different manner and they can be grouped in two main categories, according to social planner's objectives. While the first category gives priority to children from families with working parents, longer work hours, the second gives priority to children in disadvantaged contexts. We do not know which municipalities or what proportion of municipalities privilege one criterion rather than the other, or use some combination of both criteria

From Tables 5 and 6, we observe that childcare effects become stronger when rationing is higher, and this seems particularly true for language test scores. Actually, it is difficult to say whether the relative larger effect on children's outcomes is due to the prevalence of municipalities giving more importance to education of disadvanged children. It might be the case that even giving priority to children with working mother, childcare would be able to provide better educational inputs with respect to those the child would have received staying at home.

In order to explore potential differences, we re-estimate the base model on different subsamples of the "rationed" sample that is the sample for which $\bar{R}$ is greater than the median. We first divide the sample by low educated and high educated women. We expect that the first sub-sample will be more sensitive to the policy. Low educated women are on average less attached to the labour market, and cannot afford more expensive private childcare. Childcare provision may increase their probability of looking for a job, but also provide to their children better educational inputs than at home.

We then divide the provinces in two groups according to the level of GDP *per capita*. We expect that children from poorer backgrounds benefit more from childcare availability.

Table 8 reports childcare coverage coefficients for both samples. We find strong effects of childcare coverage on mother's working status for low educated mothers and in provinces characterized by low GDP.These results confirm previous works (Del Boca et al., 2009; Del Boca and Sauer, 2009; Bratti et al., 2005) which show that the availability of childcare (as well as other conciliation

policies) has a more sizeable effect on less educated women who, according to economic theory, are in general more responsive to changes in income and prices.

Also, when considering childcare availability impacts are stronger on language test scores for children living with low educated mothers and in low GDP areas, who are likely to benefit more from childcare opportunities than their counterparts. These results, consistent with previous findings (Melhuish et al., 2008; Havnes and Mogstad, 2010), are coherent with the hypothesis that public childcare may compensate for insufficient investments made by parents, providing educational opportunities to children living in disadvantaged backgrounds. We note that our results (both for mother's working status and language test scores) are robust both at the individual as well as the aggregate geographical level.

8 Conclusions

In this paper we explore the impact of public childcare coverage and rationing, on mother's working status and children's school performances at primary school. Using INVALSI data for the school year 2008-09, in conjunction with data on childcare coverage at province level we find a significant and positive effect on mother's working status as well as on language test scores.

In exploring the structure of public childcare, it is crucial to analyze the social planner decision-making process. In our theoretical framework in which the municipalities' decisions regarding the number of childcare slots to supply depend on the budget constraint and preferences of the local government, and the social planner may use rationing as a means to maximize her objective function. Following this approach we estimate models with different rationing levels and perform a test to determine if rationing significantly alters the relationship between household and child characteristics and the outcomes of interest.

Our results show that childcare availability plays a significant role both in increasing mothers' participation after childbirth and in contributing to children's cognitive development . When we take rationing into account ,we note that the childcare availability coefficients are always positive and significant for the dependent variables mother working status and language test score, but its impact is even greater in areas with high levels of rationing. In terms of the mathematics test score, without conditioning on rationing the coefficient associated with availability is insignificant, but when we condition on rationing we find evidence of a significant positive relationship between availability and math test scores both in low- and high-rationing areas.

These results support the notion that households "at the margin" in high rationing areas are more responsive to changes in childcare availability. By repeating our empirical analysis on subsamples, we showed that childcare impacts are stronger on the language test scores of children and the working status of mothers with low education and living in lower income areas, which we take as an indication of the importance of rationing criteria related to socio-economic status of the mother and household.

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Figure 1
Childcare coverage across Italian regions (percentage ratio between slots and population 0-2 years), 2005

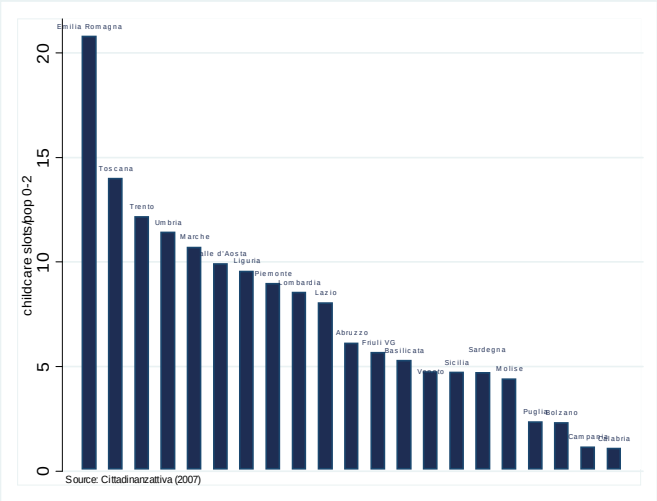

Table 1
Definitions of variables

Outcome Variables	
Mother's working status	Dummy equal to 1 if the mother works (2008-09)
Language test score	Percentage of correct answers in language test (2008-09)
Math test score	Percentage of correct answers in math test (2008-09)
Childcare Variables	
Childcare coverage	Public childcare slots over population 0-2 years by province (2005)
Rationing	Ratio of number of applications/number of slots by province (2005)
Control Variables	
Male	Dummy equal to 1 if male
Non-Italian	Dummy equal to 1 if the child has not Italian citinzenship
Father tertiary education	Dummy equal to 1 if the father has tertiary education
Mother tertiary education	Dummy equal to 1 if the mother has tertiary education
Family information missing	Dummy equal to 1 if the child has family information missing
Child information missing	Dummy equal to 1 if the child has individual information missing
GDP *per capita*	Gross Domestic Product *per capita* by province (Thousands Euro)

Figure 2
Applications to childcare facilities and available slots (absolute numbers) by region, 2005.

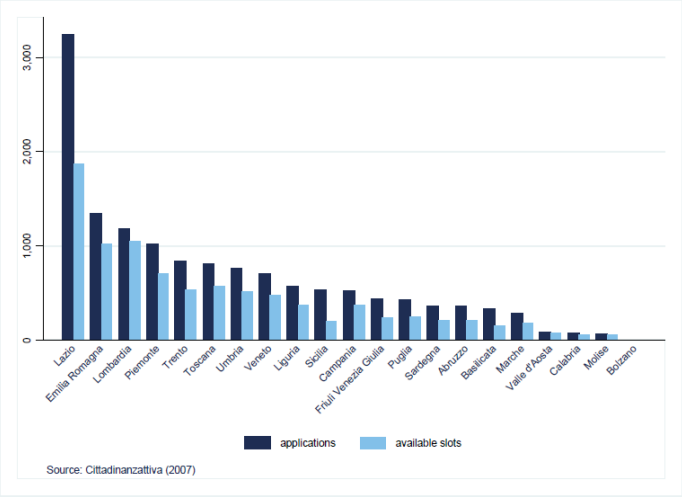

Figure 3
Correlation between mothers' working status and childcare coverage, by region.

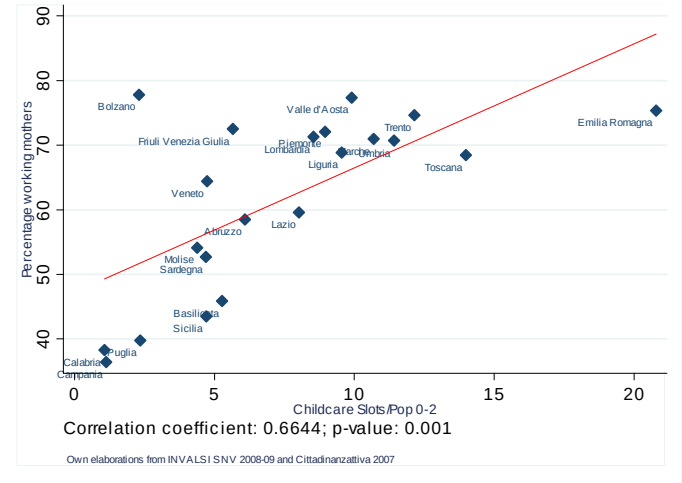

Figure 4
Correlation between average test scores (language and math scores) and childcare coverage, by region.

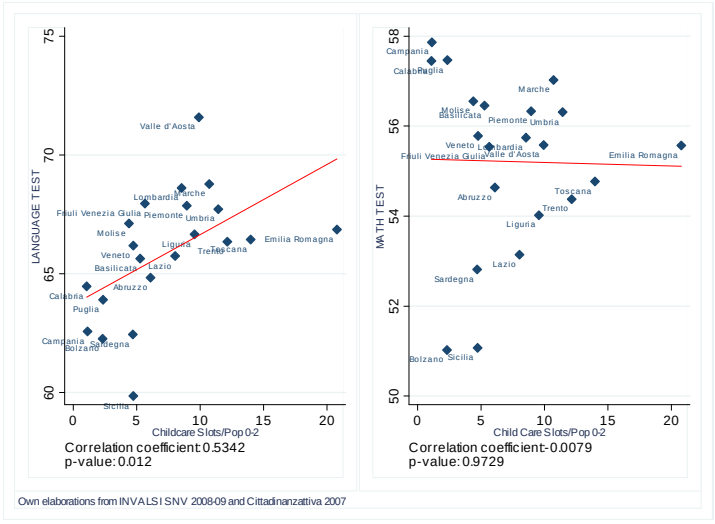

Table 2
Descriptive Statistics

	Mean	SD	Median	Min	Max
Outcome Variables					
Mother's working status	0.62	0.48	1	0	1
Language test score	66.19	21.50	70.59	2.94	100
Mathematics test score	55.47	18.12	54.17	4.17	100
Childcare Variables					
Childcare coverage	8.07	5.71	6.77	0.32	25.47
Rationing	1.68	0.65	1.49	1	3.94
Control Variables					
Male	0.51	0.49	1	0	1
Non-Italian	0.04	0.19	0	0	1
Father tertiary education	0.14	0.35	0	0	1
Mother tertiary education	0.16	0.37	0	0	1
Family information missing	0.36	0.48	0	0	1
Child information missing	0.11	0.31	0	0	1
GDP *per capita*	23.15	5.57	24.27	12.73	36.76

Table 3
Mean characteristics of all sample (a), of the subsample used in Equation 1 (b) and of observations excluded from the estimation in Equation 1 (c).

	(a) All sample	(b) Sample in Eq. 1	(c) Excluded from Eq.1	t test (a=b)	t test (b=c)
Male	0.51	0.51	0.51	−0.26	−0.42
	(0.00)	(0.00)	(0.00)		
Non-Italian	0.04	0.03	0.06	7.73***	12.39***
	(0.00)	(0.00)	(0.00)		
Mother education (tertiary)	0.16	0.16	0.18	0.26	1.23
	(0.00)	(0.00)	(0.01)		
Father education (tertiary)	0.14	0.14	0.20	0.81	4.70***
	(0.00)	(0.00)	(0.01)		
Childcare coverage	8.01	7.66	8.78	14.47***	19.48***
	(0.03)	(0.00)	(0.05)		
GDP *per-capita*	23.14	23.07	23.28	2.76***	3.70***
	(0.03)	(0.00)	(0.04)		
N	43073	27673	15400		

Notes: t-test for the null hypothesis of equal mean in the two samples (a-b and b-c).
Standard errors in parentheses. Significance level: *** p<0.01.

Table 4
Estimates from the base RE GLS model.

BASE MODEL			
	(a) Mother's Working Status	(b) Language test score	(c) Math test score
Childcare coverage	0.013***	0.178***	−0.012
	(0.002)	(0.052)	(0.047)
Male	0.004	−1.030***	2.188***
	(0.005)	(0.202)	(0.220)
Non-Italian	−0.228***	−11.062***	−5.493***
	(0.022)	(0.704)	(0.488)
Mother tertiary education	0.241***	5.957***	4.089***
	(0.014)	(0.355)	(0.435)
Father tertiary education	0.058***	5.856***	3.302***
	(0.011)	(0.359)	(0.302)
Child Missing Information	−0.009	0.327	1.110
	(0.044)	(0.780)	(0.826)
Family Missing Information		−0.812**	−0.661*
		(0.395)	(0.340)
GDP *per capita*	0.007***	0.155***	0.095*
	(0.002)	(0.056)	(0.054)
Constant	0.300***	60.657***	51.590***
	(0.042)	(1.281)	(1.323)
Within R-squared	0.053	0.032	0.019
Between R-squared	0.463	0.153	0.046
Overall R-squared	0.094	0.035	0.019
Rho	0.044	0.019	0.027
N.Clusters	100	100	100
N.Observations	27673	43073	43073

Notes: RE (GLS) model. Sample: students enrolled in II Grade 2008-09 performing language and math tests.
In column (a), we keep only observations without missing family information.
Standard errors in parentheses, clustered at province level and robust for heteroskedasticity
in case of dichotomous outcome. Significance levels:* p<0.1, ** p<0.05, *** p<0.01.

Table 5
Estimates by level of rationing in public childcare access. Dependent variable: mother's working status.

Dep. Var.	MOTHER'S WORKING STATUS		
	R>25th perc.	**R>50th perc.**	**R>75th perc.**
Childcare Coverage	0.009**	0.011***	0.013***
	(0.004)	(0.003)	(0.002)
Childcare Coverage* d_p	0.007*	0.007**	0.006*
	(0.004)	(0.003)	(0.003)
Male	0.004	0.004	0.004
	(0.005)	(0.005)	(0.005)
Non-Italian	−0.159***	−0.213***	−0.227***
	(0.031)	(0.032)	(0.025)
Non-Italian* d_p	−0.085**	−0.021	0.010
	(0.040)	(0.044)	(0.051)
Mother tertiary education	0.218***	0.233***	0.240***
	(0.028)	(0.020)	(0.017)
Mother tertiary education* d_p	0.031	0.015	0.002
	(0.032)	(0.028)	(0.029)
Father tertiary education	0.055***	0.048***	0.054***
	(0.017)	(0.014)	(0.012)
Father tertiary education* d_p	0.003	0.018	0.012
	(0.022)	(0.021)	(0.025)
Constant	0.329***	0.315***	0.304***
	(0.052)	(0.046)	(0.042)
Within R-squared	0.053	0.052	0.052
Between R-squared	0.495	0.495	0.485
Overall R-squared	0.094	0.093	0.092
Rho	0.043	0.045	0.043
N.Clusters	97	97	97
N.Observations	27339	27339	27339

Notes: RE (GLS) model. Sample: students enrolled in II Grade 2008-09 performing language and math tests, without missing family information. Other controls: d_p, GDP and child missing information.
Standard errors in parentheses, clustered at province level and robust for heteroskedasticity.
Significance levels:* p<0.1, ** p<0.05, *** p<0.01.

Table 6
Estimates by level of rationing in public childcare access. Dependent variables: language and math test scores.

Dep. Var.	LANGUAGE SCORE			MATH SCORE		
	R>25th perc.	**R>50th perc.**	**R>75th perc.**	**R>25th perc.**	**R>50th perc.**	**R>75th perc.**
Childcare Coverage	0.041	0.082	0.088*	−0.106	−0.068	−0.077*
	(0.089)	(0.062)	(0.050)	(0.068)	(0.052)	(0.045)
Childcare Coverage*d_p	0.184*	0.199*	0.448***	0.134	0.130	0.290**
	(0.109)	(0.108)	(0.101)	(0.097)	(0.107)	(0.121)
Male	−1.052***	−1.053***	−1.053***	2.179***	2.178***	2.178***
	(0.203)	(0.203)	(0.203)	(0.222)	(0.221)	(0.221)
Non-Italian	−12.092***	−10.413***	−11.150***	−6.366***	−5.648***	−5.634***
	(1.732)	(1.074)	(0.904)	(1.274)	(0.769)	(0.636)
Non-Italian*d_p	1.453	−1.171	0.543	1.171	0.312	0.478
	(1.891)	(1.404)	(1.345)	(1.377)	(1.004)	(0.917)
Mother tertiary education	6.138***	5.982***	5.819***	4.662***	4.046***	3.697***
	(0.608)	(0.441)	(0.414)	(0.757)	(0.557)	(0.502)
Mother tertiary education*d_p	−0.216	−0.001	0.583	−0.706	0.174	1.623*
	(0.726)	(0.671)	(0.776)	(0.935)	(0.874)	(0.862)
Father tertiary education	5.094***	5.760***	5.692***	2.723***	3.175***	3.129***
	(0.723)	(0.545)	(0.412)	(0.515)	(0.398)	(0.326)
Father tertiary education*d_p	0.946	0.082	0.393	0.769	0.232	0.577
	(0.827)	(0.712)	(0.790)	(0.621)	(0.600)	(0.756)
Constant	61.439***	60.865***	60.910***	52.369***	51.754***	51.967***
	(1.487)	(1.242)	(1.231)	(1.375)	(1.396)	(1.306)
Within R-squared	0.032	0.032	0.032	0.020	0.019	0.020
Between R-squared	0.190	0.187	0.228	0.071	0.065	0.111
Overall R-squared	0.036	0.036	0.036	0.020	0.020	0.021
Rho	0.020	0.019	0.017	0.026	0.026	0.026
N.Clusters	97	97	97	97	97	97
N.Observations	42592	42592	42592	42592	42592	42592

Notes: RE (GLS) model. Sample: students enrolled in II Grade 2008-09 performing language and math tests.
Other controls:d_p, GDP, child missing information and family missing information.
Standard errors in parentheses, clustered at province level. Significance levels:* p<0.1, ** p<0.05, *** p<0.01.

Table 7
F-statistics from the estimations using different level of rationing in public childcare access.

	R>25th perc.		**R>50th perc.**		**R>75th perc.**	
	F-test	p-value	F-test	p-value	F-test	p-value
Dep. Var.: Mother's working status	10.44	0.06	5.43	0.36	4.69	0.45
Dep. Var.: Language score	3.62	0.60	4.69	0.45	28.76	0.00
Dep. Var.: Math score	5.09	0.40	1.89	0.86	18.14	0.00
N with R>treshold	32014		21449		11213	

Notes: F-test for the null hypothesis that coefficients of variables interacted with d_p are jointly equal to zero.
Variables interacted with d_p are: childcare coverage, non-Italian, mother tertiary education and father tertiary education.

Table 8

Heterogeneous effects by: (a) mother's level of education; (b) province's GDP *per capita*. Childcare coverage coefficients only.

Panel (a)	**LOW EDUCATED MOTHERS**	**HIGH EDUCATED MOTHERS**
Dep. Var.	**Mother's working status**	**Mother's working status**
Childcare coverage	0.021***	−0.001
	(0.002)	(0.002)
N	11609	2325
Dep. Var.	**Language score**	**Language score**
Childcare coverage	0.265**	0.067
	(0.105)	(0.125)
N	12139	2447
Dep. Var.	**Math score**	**Math score**
Childcare coverage	0.039	0.070
	(0.094)	(0.141)
N	12139	2447
Panel (b)	**LOW GDP**	**HIGH GDP**
Dep. Var.	**Mother's working status**	**Mother's working status**
Childcare coverage	0.019***	0.013**
	(0.002)	(0.006)
N	8019	5915
Dep. Var.	**Language score**	**Language score**
Childcare coverage	0.235**	0.468*
	(0.095)	(0.240)
N	12169	9280
Dep. Var.	**Math score**	**Math score**
Childcare coverage	0.064	0.061
	(0.106)	(0.207)
N	12169	9280

Notes: RE (GLS) model. Sample: II grade students living in provinces with R>50th perc. (21449 obs.).
High educated mothers have at least tertiary education; GDP is high if higher than 27 thousands of Euro.
Controls: father with tertiary education, male, non-Italian, child missing information, family missing information.
Standard errors in parentheses, clustered at province level and robust for heteroskedasticity
in case of dichotomous outcome. Significance levels:* p<0.1, ** p<0.05, *** p<0.01.

A The INVALSI data

The Italian Institute for the Evaluation of the Education System (INVALSI) have begun a yearly survey of learning achievements both at primary and secondary school in the 2008-09 (specifically in second and fifth grades (ISCED level 1). This evaluation concerned a sample of 45,979 students for each grade, enrolled in 1,069 schools, representing 8.3 percent of the total population at primary school.

For second graders, INVALSI defines two assessment tools: a test for language and a test for mathematics. Each test is composed by a different number of items (i.e. questions), as shown in the following table**.** The majority of items are multiple-choices questions.

Test	**Time**	**Number of Items**
Language	30 minutes	34
Math	30 minutes	24

The main tests are those for language and mathematics. The language test includes questions on text comprehension, knowledge of Italian grammar and language and sentence construction. The mathematics test include mathematics questions which evaluate students' knowledge of mathematical concepts, use of number patterns and their ability to read graphs. These tests have been designed following the experience of the leading international assessments, as IEA-PIRLS and OCSE-PISA.[1] For further details on INVALSI assessment design see INVALSI (2009).

School administrations provide to INVALSI information on the children's and parents' background characteristics. The school staff are required to provide data on children's gender, birthplace and citizenship, together with information on parents' birthplace, education and occupation, as long as they are available from administrative records.

[1] The programme IEA (International Association for the evaluation of Educational Achievemment) and PIRLS (Progress in International Reading Literacy Study) provides international assessments of fourth grade students in reading, while the programme OCSE-PISA (Programme for International Student Assessment) evaluates 15-years-old students across OECD countries in reading, sciences and math competencies.