The Starting Age of non-Maternal Care and Child Development

Margarida Rodrigues

Faculdade de Economia, Universidade Nova de Lisboa

Colégio de Campolide

Campus de Campolide

1099-032 Lisboa

m.margarida.r@fe.unl.pt

It is clearly established in the literature the importance of early childhood for future economic outcomes. It is therefore important to understand what type of experiences during this period may harm or promote child development. One of these experiences is participation in child care.

In this paper I use a sample of 1035 children from the National Institute of Child Health and Human Development Study of Early Child Care (NICHD), which is a study that provides very detailed child care information. With this data I know when the child experienced for the first time non-maternal care, i.e. the months old when the child attended some type of care for the very first time either. The purpose of this paper is to assess the effect of the starting age of non-maternal on child cognitive development measured at 54 months old.

I acknowledge that the starting age is most likely endogenous and therefore use an instrumental variable approach. As the children in NICHD come from 9 different U.S. states, we use state variation in child maximum age to start compulsory school for identification. Overall, the results indicate that non-maternal care is a negative experience. However when we distinguish between child care types we conclude that: care by relatives is positive; attending a child care home facility is negative; attending a child care center is positive, in particular if it occurs around the second year of life. We find evidence of heterogeneous effects accordingly to the mother's level of education. While the care by relative is good, regardless of mother's education, attending a child care center is beneficial for children from low educated mothers and harmful for children from high educated mothers.

Keywords: Child care, Early childhood development, Cognitive outcomes, Instrumental variable estimation.

JEL codes: C21, I29.

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1 Introduction

Child care is nowadays used by the large majority of children in industrialized countries, therefore it is important to assess its effects on child development. Besides participation per se there are other dimensions of child care that may potentially affect child development, and therefore should be taken into account. One of these dimensions is the starting age of child care: to what extent starting child care sooner or later in life affects child development? This is an important question as the separation from the mother can have different effects in different ages, depending on child's needs. Because the starting age does not imply that child care is a continuous activity through out child's life, it is important to consider the other dimension of child care- intensity, i.e. the amount of child care that the child is exposed to until compulsory school begins.

The purpose of this paper is to analyze the potential effects that child care experiences may have on child development on these two dimensions: starting age and intensity. Several papers already assessed the impact of child care participation, but the results are mixed. The two dimensions studies in this paper have been less explored in the literature. Interestingly, there is an important literature that tries to answer the same question, regarding starting age, but for compulsory school. This literature is mainly for the U.S., where states have different regulations regarding the minimum age children may apply to start compulsory schooling. However, as this is just a guideline and parents may decide to enrol children sooner or later than this minimum age, there is variation in entry age, which is explored to find causal associations between entry age to kindergarten and child future development. There is clear evidence that postponing the school entry by one year is beneficial for children's short and long run outcomes, mainly because children are more mature and abler to learn and also because they are more likely the oldest in class (Bedard and Dhuey (2006), Datar (2006), Elder and Lubostky (2008)).

It might be even more important to find evidence for younger children for two reasons. First, economic and psychological literatures suggest that early childhood is a crucial period for child development and future outcomes. Second, there are no state nor federal guidelines regarding the starting age in child care arrangements. Basically this is a decision solely made by families, which in turn means that children may have totally different child care experiences. For instance one child can start child care immediately after birth while other may never attend child care until she starts compulsory school. If in fact, child care experiences do affect child development, these two children will have very different inputs at school entry, not only because of their family and environmental background, which is consistently reported in the literature as the most important child development determinant, but also in this other aspect. Of course, participation in child care may alleviate or reinforce the background effect. For instance,

if disadvantaged families choose to start child care sooner in child's life, and if child care is positive for development, then child care alleviates the background effect. But, if child care is negative for child development, the child care experience reinforces the negative background. Furthermore, it can be that child care experiences have different results depending on the type of child care used or on the group of children analyzed, i.e. disadvantaged versus advantaged. Therefore it is crucial to assess the effect of child care experiences, i.e starting age and intensity, on child development and to what extent this effect depends on the child care type and on the group analyzed.

A major concern in estimating the effect of child care experiences on child development has to do with data drawbacks. In order to find a causal relation the researcher needs to take into account that families/mothers who choose more child care can be systematically different from those who do not use it at all or use it less and that there is unobserved heterogeneity with respect to child, mother, family and environmental characteristics.

In this paper we try to deal with these problems by applying instrumental variable methodology to data from National Institute of Child Health and Human Development Study of Early Child Care (NICHD), which offers the opportunity to control for many of the characteristics mentioned above. Another crucial advantage of these data is that provide very detailed information about child care history of each child. In particular, we have very frequent information about child care participation in several types of arrangements (father, grandparents, relatives, non-relatives, child care home and child care center), which provides the means to compute the starting age and intensity for each type of child care. We exploit the variation in the maximum age to start compulsory school between U.S. states to find the causal relation we are interested in. We prove that these instruments are strong and control for state regulations and characteristics to enforce the assumption that the instruments are exogenous.

The paper proceeds as follows. In Section 2 we review the relevant literature. Section 3 describes the data used in this paper, defines the outcome, treatment and control variables. We present our methodology, the instruments and the assumptions made in Section 4. In Section 5 we analyze the main results. Finally, Section 7 concludes.

2 Literature Review

2.1 The importance of early childhood

The importance of early childhood is well established in several sciences such as neuroscience, psychology and economics. Neuroscience and psychological literature establishes that early childhood is a crucial period for children development. Recent studies on brain

development highlight the importance of good nutrition and high quality experiences in the early years for future skill development (Shore (1997) and Shonkoff and Phillips (2000)). These sciences suggest that that there are crucial periods in life to acquire specific abilities and, once these are missed, remediation can be difficult or even impossible.

In the economics literature there are several reasons, related with both efficiency and equity concerns, to consider early childhood as one the most important periods to invest in human capital and as a potentially successful area for policy intervention. Not only investments made during this period have a longer payoff period (Becker (1964)) but the returns to the investment in human capital seem to decline exponentially during the life cycle, being the highest in early childhood (Carneiro and Heckman (2003)). Also, Currie (2001) suggests that families may under-invest in early childhood due to market failures: they may have liquidity constraints, information failures and they more likely ignore the positive externalities of investing in this period of life. The idea of complementarity between investments made in different periods of the life cycle is also supported by the economic literature: skills acquired during early childhood facilitate the acquisition of new skills later on in life (Heckman (2000) and Cunha et al (2006)). This means that, if there are also equity concerns, early childhood should be considered the privileged period for equalizing endowments skills. In fact, Currie (2001) suggests that equalizing skills in early childhood is more cost effective than compensating for differences in outcomes later in life. Furthermore, empirical studies prove that achievement gaps between children from different backgrounds emerge very early in life, as early as ages 1 and 2, and if anything schooling exacerbates them (Carneiro and Heckman (2003) and Fryer and Levitt (2004)). This suggests that the skills acquired before school entry already condition the future achievement of children.

2.2 The effect of maternal employment and child care on children development

The unprecedented increase in female labor force participation in the last century motivated a large literature attempting to evaluate the effects of maternal employment on child development. The conclusions differed due to methodology and data used. The majority of the papers fail to correct for selection bias which is problematic in the sense that mother's decision to work depends on mother's characteristics and therefore maybe it is not maternal employment status that may be affect the child but the mother's characteristics that led to that status. If the researcher does not take this into account then it cannot be made any causal inference. In recent years there have been several papers using either fixed effects models (Ruhm (2004)), propensity score matching models (Han et al (2001), Berger et al (2005), Hill et al (2005), Baum II (2003)), structural models (Liu et al (2003) and Bernal (2008)) or instrumental variables models (Blau and Grossberg (1992)) giving some confidence that the effects found are in fact causal ones. Despite the differences found regarding the sign of the overall effect of

maternal employment on children development, there has been some consensual results that this effect is negative, particularly in the first year of child's life (Han et al (2001), Ruhm (2004), Liu et al (2003), Bernal (2008), Brooks-Gunn et al (2002) and Baum II (2003), etc). Interestingly there is evidence that, even controlling for family income, the increased family income due to maternal employment, only partially offsets the negative effects of maternal labor supply (Baum II (2003)).

There is evidence, at least in U.S.A., that child care is not an exclusive practice of working mothers. Barnett and Yarosz (2007) show that, in 2005, 88% of 4 years old children of employed mothers attended child care regularly, while the same figure for non employed mothers was 66%. The correspondent figures for 3 years old children are 83% and 44%, respectively. It is clear that an important fraction of children of non working mothers attend a regular child care arrangement and therefore maternal employment is not the only variable explaining this phenomenon. An analysis of the effect of child care attendance per se, regardless of maternal work status is therefore necessary.

There is a large body of research examining the impact of child care on children's development. The only consensual result of this literature is the positive effect of early childhood programs targeted to disadvantaged children (Currie(2001)). Less is known about more general and typical child care arrangements. Some papers find an insignificant effect (Burchinal et al (1995)), others a positive effect (Duncan and NICHD (2003), Berlinski et al (2008), Gromley et al (2005)) and others a negative effect (Baydar and Brooks-Guun (1991), Vandell and Corasaniti (1990), Desai et al (1989), NICHD (2000), Bernal and Keane (2009), Herbst and Tekin (2010), Baker et al (2008)). This variety of results stem from the different samples and methodologies used. The majority of the papers suffer from identification problems by considering child care participation as exogenous (Baydar and Brooks-Guun (1991), Vandell and Corasaniti (1990), Desai et al (1989), NICHD (2000) and Burchinal et al (1995) just to name a few). However in the recent years several papers have tried to deal with the endogeneity and the selection bias problem in several ways: using child, family or school fixed effects models, propensity score matching models, differences-in-differences models or instrumental variables. Even among these studies the conclusions are not consensual. For instance, Bernal and Keane (2009) uses welfare policy rules as instruments for child care participation in a sample of single mothers' children from NLSY. They find that child care affects negatively the cognitive development of children between 3 and 6 years old. Berlinski et al (2008) use both household fixed effects and instrumental variables models on a Uruguayan household survey sample of children between 7 and 15 years old. Both models indicate that pre-school attendance is associated with a higher probability of school attendance and, interestingly, this positive effect increases monotonically as children get older. Magnuson et al (2007) use data from

ECSL-K, which follows children from the kindergarten until first grade. When children were evaluated in the fall of kindergarten, all the methodologies used suggest that pre-kindergarten attendance is associated with higher performance in cognitive tests but also with more behavioral problems. When the same children were re-evaluated in the spring of first grade, the effects on cognitive tests have dissipated while the negative behavioral effects still persisted.

Two other papers analyse the effects of policies that promote child care usage on children development. Baker et al (2008) exploit the introduction of highly subsidized, universally accessible child care, only in Quebec but not in other Canadian cities to estimate a differences-in-differences model. They conclude that the program dramatically increased parental labor supply and had large negative effects in child health and behavior. Furthermore, parents presented more hostile, less consistent parenting and poorer health. For U.S., Herbst and Tekin (2010) use instrumental variable model and find that receiving a child care subsidy one year before the kindergarten lowers cognitive test scores and increases a variety of behavioral problems at kindergarten entry.

Another issue beyond child care participation is the child's starting age in these types of arrangements and the effect that it may have on children development. This has not been a much studied issue in the literature. To my knowledge, the only paper that explicitly deals with the starting age of child care is Loeb et al (2007). The authors conclude that, regardless the entry age to a center arrangement, attendance improves reading and maths skills at kindergarten entrance. Furthermore, the greatest benefit of center care occurs for those children who started it between 2 and 3 years old. Interestingly, for behavioural outcomes the conclusions are very different: center care increases behavioural problems and this negative effect is larger the earlier the child enters. However, the paper presents two important drawbacks that we are able to solve in this paper. First, despite the attempt to solve the selection bias problem by using instrumental variables, the authors found that the instruments are too weak to make any meaningful conclusions from this analysis. Therefore the authors relied on the OLS and matching methodologies, which provide very similar results. Second, the data used do not include parents' reports on continuous usage of care. Instead, parents were asked to indicate their child's age on initial entry, therefore it does not imply continuous enrolment.

3 Data

We use data from the National Institute of Child Health and Human Development Study of Early Child Care (NICHD). This is an unique longitudinal dataset that has followed 1364 children from 10 sites, in 9 states[1], around the U.S. since the time of their birth, in 1991. The

[1] The 9 U.S. states are: Arkansas, California, Kansas, New Hampshire, Pennsylvania, Virginia, Washington, North Carolina and Wisconsin.

study recruited mothers giving birth during selected 24 hour sampling periods and the sampling plan was designed to ensure sufficient sample size for a variety of factors, but it was not intended to be a representative national sample. The study itself had some exclusion criteria: mother's or child's medical complications, mother less than 18 years old, multiple births, mother not fluent in english or expecting to move soon. These exclusion criteria suggest that the sample is, at least to some degree, more advantaged than the average population with respect to some socioeconomic indicators.

This is a longitudinal study that followed the children through time in four phases: i) birth through 36 months; ii) 42 months through first grade; iii) second through sixth grade; iv) has now been released data from the fourth phase in which children are 14 and 15 years old. Because we want to analyze the effects of child care on child's outcomes before the beginning of compulsory school we focus only in the first two phases. Furthermore, as children may begin compulsory school in different ages, depending on the state's regulations about this, we measure child's outcome variables at 54 months old, the last assessment point at which no children had yet experienced compulsory school. During these two phases, NICHD collected a bunch of child's, mother's and family's characteristics as well as very detailed information about child care. There were 5 main assessment points (at 6, 15, 24, 36 and 54 months old) and many auxiliary data collection points in between the previous ones, made by phone (at 3, 9, 12, 18, 21, 27, 30, 33, 42, 46 and 50 months old). So, approximately every 3 months we have information about at most three child care arrangements, in which the mothers are asked about the type of child care used (father care, relative care, at home non relative care, family day-care by non-relative and child care center) and the hours per week spent in each.

Our analysis begins to study the effect of non-maternal care on child development, regardless of the type of child care. However, as there are several child care types, the effect found may hide different effects from different types of care. Therefore we next decompose the non-maternal care in 3 types. The first is what we call IN: this type includes the case when the child is cared by a relative (father, grandparents or other relatives) or in her own home (even if not by a relative). This type of care is intended to capture the effect of being cared by relatives or in child’s home and environment. The other two types of care are child care center and child care home facility. In contrast with IN, in these types of care the child is exposed to other environment and caregivers rather than the ones she is used to. We will analyze these two types of care separately, instead of aggregating them into one sole category (OUT) because, as we will see later on, the effects on child development are very different.

3.1 Child care treatment variables

Based on every collection data points we can have a very detailed picture about the history of child care in each type of care. From the collection data points (about every 3 months) we come up with monthly indicators for whether the child has attended each type of child care in each month[2]. Furthermore, if indeed the child attends a certain type of child care we know for how many hours a week.

We have two different variables concerning child care usage:

1. We are primarily interested in the timing that this experience happened for the first time, and we can have this information by the monthly indicators we created. The variable we use, which we call Care1st, is obtained by the difference between 54 months old, i.e. the child's age at the assessment point, and the months old the child was when attended any or a particular child care type for the first time. This variable is interpreted as "how many months ago did the child attended for the first time child care for at least 10 hours per week". So, for this treatment we compute the following variables: **Care1st_Any** (how may months ago the child experienced any type of child care for the first time), **Care1st_In** (how may months ago the child experienced care by a relative or in her own home for the first time), **Care1st_CCHome** (how may months ago the child experienced child care home facility care for the first time) and **Care1st_Center** (how may months ago the child experienced child care center based care for the first time).

   So, if Care1st_Center equals 0 it means that the child never attended until the 54 months old and if it equals 54 it means that the child experienced center type of care during her first month of life: the higher this variable the sooner the child attended the correspondent type of care for the first time.

2. Following Angrist and Imbens (1995), and because the previous variable does not imply continuous attendance, we also measure the exposure to, or intensity of, each type of care. This is the fraction of child's life spent either in each type of care for at least 10 hours per week. We call this variable Intensity and we have computed the following variables: **Int_Any** (fraction of child's life spent in any type of care), **Int_In** (fraction of child's life cared by a relative or in her own home), **Int_CCHome** (fraction of child's life spent in a child care home facility) and **Int_Center** (fraction of child's life spent in a child care center).

[2] We do this by finding the medium point between two collection data points and attributing: i) the information of the first collection point to the months before the medium point and; ii) the information of the next collection point to the months after the medium point.

We believe that these two variables complement each other and that together they provide a more complete picture of the child care history. We call these the treatment variables.

3.2 Outcome variables

We are interested in assessing the impact that the child care variables described above may have on the child's cognitive development. To measure child's development we use two sub-scales of the Woodcock and Johnson Psycho-Educational Battery tests, one measuring the reading skills and the other measuring the mathematical skills. As these battery tests were applied to children when they were 54 months old we call these outcome variables LW54 and AP54, respectively. We normalize these variables such that each has zero mean and the standard deviation equals one.

3.3 Covariates

Our set of controls for the child's, mother's and family's characteristics is the following: child's gender, child's race and ethnicity, child's birth order, child's birth weight in kilograms, two dummies for mother's education (one for high school completion and the other for BA completion), two dummies for partner's years of education if present (one for high school completion and the other for BA completion), mother's age at child's birth, proportion of time that the child's father lived in the household, average number of adults other than the mother and the partner living in the household, average number of children living in the household, average of family's income-to-needs ratio during the child's life and the logarithm of total family's income pre-birth.

3.4 Sample

Our sample consists of 1035 children, for whom none of the variables is missing. Table 1 presents the descriptive statistics of the data for the full sample.

4 Empirical methodology

The main equation we want to estimate in order to assess the effect of the treatment variable on the child's outcomes is the following:

$$Y_i = \alpha + \beta Treatment_i + \gamma X_i + u_i \quad (1)$$

Y_i is the outcome of interest for child i, which in this paper are the letter word identification and the applied problems standard scores measured at 54 months old. X_i is a vector of controls that include all the variables mentioned in the previous section. Treatment is one of the two variables related with child care mentioned in the previous section and we estimate equation (1) for each of the two treatment variables separately. β is our parameter of interest as it measures the impact of the treatments on the child's outcome. Estimating β by OLS will provide an

unbiased and consistent estimator if and only if $\text{cov}(Treatment, u \mid X) = 0$, which most likely does not hold. For instance, child's ability and maturity most certainly affect the outcome of the equation and yet it is not observable. If furthermore the treatment variable, i.e. the family's decision about child's participation in child care is related with child's ability, then treatment is what is called an endogenous variable in equation (1). For instance, if mothers that have more (less) able children decide to start child care sooner (later), there exists a positive correlation between the treatment and the error term.

In order to identify β consistently we use an instrumental variable approach. We find an exogenous variable to equation (1), call it Z, meaning that it must be able to predict the Treatment but it must be uncorrelated with the error term. In other words, it should not have any effect on the outcome apart from the indirect impact through the Treatment.

$$Treatment_i = \theta + \pi Z_i + \lambda X_i + v_i \quad (2)$$

where Z is the instruments' vector for Treatment and X is used as an instrument to itself. The predicted treatment is then used in equation (1). As in all instrumental variables models, estimates of β identify local average treatment effects (LATE) among children whose actual Treatment is affected by the instrument (Imbens and Angrist 1994 and Angrist and Imbens 1995).

To instrument both the treatment variables we use the maximum age at which children must attend compulsory school. This is a regulation that varies across states[3], therefore we exploit this variation to identify β. We believe that the maximum age is likely to affect the decisions regarding child care usage, as the family may manage differently child care depending on whether the child must be in compulsory school by age 5 or only 3 years later, at 8 years old. However, the sign of the relationship between the instrument and the treatment variables is not theoretical clear. For instance, it can be that in states with high maximum age the families are more likely to start child care later in life and use it less intensively, as the compulsory may start later as well. But it can also be that they choose to start child care sooner and use it more intensively if they choose to indeed start compulsory school later in child's life.

In our sample it seems that, on average, families in states allowing for a higher maximum age to start compulsory school are also those who decide to start child care sooner in life and to use it more intensively. This indicates a positive correlation between the instruments and the treatments.

So, we rely on the variation of the child care regulations between states to identify parameter β. As already explained our strategy is valid if two conditions are met: i)

[3] The maximum age is as low as 5 in two states (Arkansas and Virginia) and as high as 8 in two states (Pennsylvania and Washington). In between, 6 is the maximum age for California, New Hampshire and Wisconsin, whereas for Kansas and North Carolina it is 7 years old.

$\text{cov}(\max Age, Treatment \mid X) \neq 0$; and ii) $\text{cov}(Treatment, u \mid X) = 0$. In the next section, when we present the results of the first stage equation, we provide evidence that indeed the first condition holds, that is we show that the instrument is correlated with the treatments, after controlling for the other determinants we consider in the model.

The second may not meet if the maximum age at which children must be in compulsory school is related with the error term in equation (1), i.e. is related with variables that affect children outcomes. One way to solve this potential problem is to control for the variables which we believe are related with both the outcomes and the instrument. One such group of variables is the state child care regulations. These regulations most likely affect the development of children that use child care and can be related with the instrument if for instance states that allow entrance age to be higher adopt stringent child care regulations. Therefore we control for the following child care regulations at the state level: the average maximum children-caregiver ratio in a child care center, the minimum years of education to become a child care center director, the amount of annual ongoing training required to caregivers and the minimum hours of child development coursework required for the director of a child care center[4]. The other group of variables is state average characteristics. The instrument would not be exogenous if, for instance, states which set lower maximum age to start compulsory school are systematically different from the states that set higher maximum age. Therefore we control for the following state characteristics: the state's median income, the percentage of female labor force participation and the percentage of women in state legislatures[5]. By controlling for all these state regulations and characteristics we believe that our attempt to isolate the effect of the instrument on the treatments is successful.

So, the vector of covariates X in equation (1) and (2) include all these state specific variables. The complete set of covariates, child and family covariates and state covariates, can be seen in Table 1.

5 Results

5.1 First stage results

Table 2 presents the estimates of equation (2). Indeed, except for one case, we can reject the hypothesis that the instruments do not affect the Treatment variables. The instrument

[4] The following variables were also included but were dropped due to colinearity: maximum children-caregiver ratio allowed in a child care home and the maximum group size in a child care center, but these were dropped due to colinearity. We also included a dummy variable indicating the existence of maternity leave policies, but it was also dropped.

[5] The following variables were also included but were dropped due to colinearity: percentage of white population, the percentage of population under 5 years old, the percentage of population holding a BA degree, the per capita expenditure in elementary and secondary school and the percentage of single parent families.

coefficients are significant at least at 5% significance level and the F statistics are well above the threshold level 10. These figures suggest that indeed our instrument, the maximum age at which children must be attending compulsory school strongly predicts our treatment variables.

In table 2 the instrument seems to be a poor determinant of the intensity of child care center usage. When an instrument is weak, point estimates are biased and Wald tests are unreliable. Whenever this is the case, not only in table 2 but in every forthcoming table, we use the conditional likelihood ratio (CLR) test developed by Finlay and Magnusson (2009) which is robust to weak instruments. This indicates the confidence interval of the coefficient of interest, therefore it is not able to predict the magnitude of the effect but informs about its sign.

5.2 Second stage results

Table 3 presents the results of equation (1) using the predicted Treatment from equation (2). First we analyze the effect of any type of non-maternal care on child cognitive development. The column correspond to ANY indicates that non-maternal care is a negative experience for the child. Starting non-maternal care one month sooner in life is associated with a decrease of 3 percent of a standard deviation for mathematical skills and 5 percent for reading skills. Similarly, a child that spends all her life in non-maternal care has on average less reading skills and mathematical skills. These effects amount to one and half and one standard deviation respectively.

However, there may be different effects depending on the types of child care attended therefore it is important to disaggregate the child care types and measure the effect that each type of care in particular has on child development. Interestingly, we conclude that being cared by a relative or at her own home is not detrimental for the child reading and mathematical skills. In contrast, starting sooner and using a child care home facility more intensively during the child's life seems to harm both the skills. Interestingly, for the child care center, which is a more structured type of care, the results suggest that it is positive for the child development to start it sooner in life but it is detrimental to increase the intensity of its use too much[6]. This may suggest that the there may be an optimal age to start this type of care. This is an interesting question to answer as the center based care is the only type of care outside the family and the house that is good to attend. To infer the optimal age to start center based care we compute several dummies corresponding to the year during which the child first attended center care: start during the child's first year of life (between 0 and 11 months old); start during the child's second year of life (between 12 and 23 months old); start during the child's third year of life (between 24 and 35 months old); start after the third year of life (after 36 months old). Then we

[6] Table 2 shows that our instrument is a poor one for the Intensity of child care center based care. Even though the CLR is unable to indicate the magnitude of the effect it confirms that indeed the effect is negative.

compare the effect of starting at each of these periods to start before or after that period. The results of this exercise are presented in table 4. While it is better to start during the first year than after, it is also better to start during the second year rather than the first. Starting at the second seems better than after. Starting at the third year is better than starting before and better than starting after, while starting at the fourth year of life or later seems negative. These results suggest that the best practice is to enrol children in a child care center during her second or third year of life.

5.3 Heterogeneous effects

In this subsection we ask to what extent some of the results presented in the previous ones differ accordingly to the child's background. The literature on education considers the mother's level of education as the most important factor for child's achievement. Therefore we analyze the effects separately for two groups of children: one with low educated mothers (those who do not hold a BA degree) and one with high educated mothers (those who do hold a BA degree). This is an interesting question as the extent to which non-maternal care benefits or harms child development depends ultimately on the relative quality of the care received by the mother when compared to the one receive in the alternatives types of care. So, we may expect that the children from low educated mothers may benefit from non-maternal child care, in particular if this is a high quality one.

Table 5 presents the results of this exercise. We compare the effects of the In, child care home facility and child care center based care types of care. The results are indeed very interesting. The care from relatives or at her own home seems to be beneficial, regardless of mother's education. This may suggest that the family support and environment is positive, regardless of the background. Attending a child care center seems to benefit children from low educated mothers while harming those from high educated mothers. Indeed it seems that the former group of children benefit from a more structured type of care, which probably promotes development better than the care received at home or by relatives. For the latter group of children, there is no benefit in attending child care centers as most likely the care received at home and by relatives is already a high quality one.

6 Conclusion

It is clearly established in the literature the importance of early childhood for future economic outcomes. It is therefore important to understand what type of experiences during this period may harm or promote child development. One of these experiences is participation in child care, which is already explored point in the literature. In this paper we are interested in assessing the impact of other two dimensions of child care on child development: the starting

age of non-maternal child care and the intensity of its use. These dimensions were not yet explored in the literature so we believe that this paper is an important contribution to the literature.

In this paper we use a sample of 1035 children from the National Institute of Child Health and Human Development Study of Early Child Care (NICHD), which is a study that provides very detailed child care information. With this data I know when the child experienced for the first time non-maternal care, i.e. the months old when the child attended some type of care for the very first time either. The purpose of this paper is to assess the effect of the starting age of non-maternal on child cognitive development measured at 54 months old.

We acknowledge that the starting age and intensity are most likely endogenous and therefore use an instrumental variable approach. As the children in NICHD come from 9 different U.S. states, we use state variation in child maximum age to start compulsory school for identification. Overall, the results indicate that non-maternal care is a negative experience. However when we distinguish between child care types we conclude that: care by relatives is positive; attending a child care home facility is negative; attending a child care center is positive, in particular if it occurs around the second year of life. We find evidence of heterogeneous effects accordingly to the mother's level of education. While the care by relative is good, regardless of mother's education, attending a child care center is beneficial for children from low educated mothers and harmful for children from high educated mothers.

In the future we would like to explore the role that the quality of child care has on the effects found so far.

TABLES

Table 1. Descriptive Statistics

	Mean	St. Dev.	Min.	Max.
Outcomes				
LW54 - reading skills	0.016	0.993	-2.66	4.96
AP54 - mathematical skills	0.011	0.994	-3.96	3.20
Treatments				
Care1st - Any	41.5	16.5	0	53
Intensity - Any	0.52	0.28	0	0.91
Care1st - In	29.9	22.1	0	53
Intensity - In	0.26	0.26	0	0.87
Care1st - child care Home facility	20.3	22.7	0	53
Intensity - child care Home facility	0.16	0.24	0	0.81
Care1st - child care Center	15.6	18.1	0	53
Intensity - child care Center	0.18	0.22	0	0.81
Covariates - child and family				
Child's gender (=1 if male)	0.49	0.05	0	1
Child's birth weight in kilograms	3.49	0.51	2	5.4
Child's race dummy - Black (=1 if yes)	0.11	0.31	0	1
Child's race dummy - Hispanic (=1 if yes)	0.06	0.23	0	1
Child's race dummy - Other (=1 if yes)	0.04	0.20	0	1
Child's birth order - 1	0.45	0.49	0	1
Child's birth order - 2	0.36	0.48	0	1
Mother completed high school dummy	0.53	0.49	0	1
Mother completed BA degree dummy	0.38	0.48	0	1
Partner completed high school dummy	0.49	0.50	0	1
Partner completed BA degree dummy	0.38	0.49	0	1
Mother's age at child's birth	28.6	5.50	18	46
Proportion of child's life father living in the house	0.83	0.32	0	1
Average number of other adults living in the house	0.23	0.57	0	6.3
Average number of children living in the house	1.03	0.95	0	8.5
Total income of family, pre-birth (log)	3.68	0.85	0.92	5.61
Average income-needs ratio of the family	3.59	2.68	0.18	27.3
State child care regulations				
Average of maximum children-caregiver ratio in child care centers	8.38	1.61	6.8	12.2
Years of education required to be a child care center director	12.38	4.47	0	16
Annual ongoing training required to caregivers in child care centers	160	131	0	450
Minimum hours of child development coursework required for a child care center director	13	12	0	39
State characteristics				
State's median income (in thousands)	32.3	4.52	23.8	39.6
State's percentage of female labor force participation	59.8	3.94	54.8	64.9
State's percentage of women in state legislatures	17.6	9.43	6.77	32.6

Table 2. First stage results

	ANY		**IN**		**CCHome**		**Center**	
	Care1st	Intensity	Care1st	Intensity	Care1st	Intensity	Care1st	Intensity
Instrument	-0.979	-0.034	1.674	0.031	-4.69	-0.052	1.451	-0.005
s.e	-0.445 **	-0.006 ***	0.431 ***	0.009 ***	0.558 ***	0.005 ***	0.625 **	0.007
F.st.	24.47	179.9	25.59	55.93	613.5	226.3	33.58	3.72
p-value	-0.001 ***	0.000 ***	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.089 *
Observations	1035							

The standard errors and p-values are clustered at the state level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3. Second stage results

	ANY				**IN**			
	LW54		AP54		LW54		AP54	
	Care1st	Intensity	Care1st	Intensity	Care1st	Intensity	Care1st	Intensity
β	-0.051	-1.466	-0.032	-0.932	0.029	1.624	0.019	1.033
s.e.	0.013 ***	0.316 ***	0.010 ***	0.284 ***	0.011 ***	0.559 ***	0.007 ***	0.391 ***
Observations	1035							

	CCHome				**Center**			
	LW54		AP54		LW54		AP54	
	Care1st	Intensity	Care1st	Intensity	Care1st	Intensity	Care1st	Intensity
β	-0.010	-0.959	-0.006	-0.609	0.034	-9.167	0.022	-5.828
s.e.	0.003 ***	0.271 ***	0.002 ***	0.218 ***	0.010 ***	4.668 **	0.009 **	2.476 **
Observations	1035							

The standard errors and p-values are clustered at the state level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Results from the regressions that use the dummies variables indicating the year at which the child attended center care

	Start 0-11 vs After	Start 12-23 vs Before	Start 12-23 vs After	Start 24-35 vs Before	Start 24-35 vs After	Start 36-54 vs Before
First stage results						
Instrument	0.092	-0.091	0.069	-0.103	0.025	-0.099
s.e.	0.019 ***	0.028 ***	0.011 ***	0.018 ***	0.011 **	0.02 ***
F. st.	288.3	20.62	71.09	82.22	4.808	82.01
p-value	0.000 ***	0.002 ***	0.000 ***	0.000 ***	0.059 *	0.000 ***
Second stage results						
LW54						
β	0.306	3.118	1.615	1.456	8.195	-0.283
s.e.	0.128 **	0.595 ***	0.197 ***	0.175 ***	3.528 **	0.107 ***
AP54						
β	0.461	0.056	0.863	-0.659	2.673	-0.427
s.e.	0.165 ***	0.291	0.205 ***	0.212 ***	1.552 *	0.153 ***
Observations	658	265	508	384	393	658

The standard errors and p-values are clustered at the state level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Heterogeneous effects: the effects disaggregated accordingly to mother's education

IN								
	LW54				**AP54**			
	Care1st		Intensity		Care1st		Intensity	
	Low	High	Low	High	Low	High	Low	High
Instrument	0.019	0.019	1.168	3.229	0.011	-0.012	0.629	-2.105
s.e.	0.004 ***	0.013	0.287 ***	3.385	0.004 ***	0.013	0.277 **	2.626
CCHome								
	LW54				**AP54**			
	Care1st		Intensity		Care1st		Intensity	
	Low	High	Low	High	Low	High	Low	High
Instrument	-0.014	0.006	-1.096	0.869	-0.007	-0.004	-0.591	-0.556
s.e.	0.003 ***	0.003 *	0.299 ***	0.454 *	0.003 **	0.003	0.287 **	0.457
Center								
	LW54				**AP54**			
	Care1st		Intensity		Care1st		Intensity	
	Low	High	Low	High	Low	High	Low	High
Instrument	0.042	-0.054	-5.173	-4.718	0.023	0.035	-2.788	3.075
s.e.	0.013 ***	0.046	1.532 ***	4.409	0.011 **	0.032	1.242 **	2.335
Observations	635	400	635	400	635	400	635	400

Low education group: if child's mother does not hold a BA degree.

High education group: if child's mother does hold a BA degree.

Note: The instrument is always a weak instrument for the high education group for the IN and Center types of care. The CLR robust test indicates that the effect of the Care1st treatment of the In type of care is positive for the LW54. The CLR robust test indicates that both the Care1st and Intensity treatments are negative for the Center type of care, but only for the reading skills LW54.

The standard errors and p-values are clustered at the state level.

* significant at 10%; ** significant at 5%; *** significant at 1%

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