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Abstract[1]

This paper presents a comprehensive empirical analysis of the impact of attending a child day care center on early childhood development (ECD) in Chile, examining child development from a multi-dimensional perspective. The potential endogeneity associated with the parental decision of sending children to day care centers (or preschools) is addressed. Additionally, unobserved heterogeneity is interpreted as (latent) abilities. This approach provides a unifying framework combining parental decisions, children's endowments, and child care characteristics. The results of the study suggest that: (i) cognitive and socio-emotional test scores from children younger than two are too noisy to be analyzed; (ii) analysis of enrollment in child care centers for children older than two reveals significant effects of family background, unobserved abilities, the local availability of centers, and local capacity; and (iii) enrollment in child care centers seems to boost cognitive development among children older than two.

JEL Classifications: I20, I21, I28
Keywords: Early childhood education, Child care center, Cognitive development, Chile, Economic disadvantage

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1. Introduction

The analysis of the determinants of early childhood development (ECD) is probably one of the most active areas of research in psychology, medicine, sociology, economics, and public policy. The increasing interest in ECD is explained not only by the intrinsic value associated with improving children's well-being but also by the long-term effects that it may have on individuals' outcomes later in life. If "skills beget skills," as the literature suggests, we would expect the environment faced by children during the first years of life to have significant effects on their development (Heckman, 2006). Moreover, early intervention may be the most efficient way to modify behavior (reduce crime and violence), provide equal opportunity (raise educational attainment), and improve labor market outcomes (increase wages and employment).

In recent years, the economic literature has provided evidence of the effectiveness of early childhood programs. Programs such as the Perry Preschool program (Schweinhart et al., 2005; Barnett 1996), the Abecedarian Project (Masse, 2002), and the Head Start program (Currie, 2001) have been put forth as positive examples of the effects of well-designed and intensive interventions in child development. The evidence from these cases has been used to justify public and private efforts towards the provision of out-of-home public child care services throughout the world. Figure 1 displays evidence supporting this fact. It documents the significant increase in enrollment in ECD centers observed in the last 10 years around the globe. For Latin America and the Caribbean, the enrollment rate increased from 56 percent in 1998 to 65 percent in 2005.

A second factor explaining the significant increase in ECD program enrollment rates, particularly among developing economies, is the apparent link between poverty and female labor force participation. Low female labor force participation is viewed as one of the determinants of poverty. In this sense, the availability of ECD centers may not only boost child development but also may help to increase female participation in the labor market, and consequently reduce poverty.

Unfortunately however, to our knowledge these significant efforts to provide of out-of-home child care services have not been accompanied by explicit efforts to ensure their quality. Moreover, given the high costs associated with high-quality and intensive ECD programs (Barnett, 1996), there is good reason to question the quality of such programs in low and middle-income countries. In addition, the importance of the mother's presence during the first years of

life, which is obviously correlated with maternal employment, has been well documented (Hill et al., 2005).

In summary, even though the international evidence seems to justify the positive trend of enrollment in ECD centers, it is unclear whether the effects of enrollment in ECD centers on child development are in fact positive, particularly in the context of developing economies. This paper seeks to provide an answer to this question.

This paper presents an empirical analysis of the demand for out-of-home child day care services and assesses the consequences of enrollment in ECD centers in the case of Chile. The empirical strategy incorporates recent developments in the econometric literature. In particular, it considers the role of unobserved parental abilities as determinants of the demand for child care services, which may cause selection biases, and the intergenerational link between unobserved child and parental endowments. Given the setup, the analysis also carefully defines the treatment parameters of interest. The identification of the relevant treatment effects relies on the availability of rich information.

The empirical analysis was carried out using a new data set containing detailed information combining child developmental outcomes (cognitive, socio-emotional, and health measures), household-level information (parental background, family environment), and child-care center availability. To our knowledge, this is the first dataset specifically designed to assess the demand for and the impact of ECD centers in Latin America and the Caribbean. Furthermore, the case of Chile is particularly important given the recent public efforts to increase ECD enrollment and to incentivize female labor market participation.

The paper is organized as follows. Section 2 discusses the literature and explains why Chile is a case of particular interest. Section 3 introduces the economic model justifying our empirical approach. It also discusses the identification argument and defines the treatment effects. Section 4 describes our data and empirical strategy. Section 5 presents our results. Section 6 concludes.

2. Background and Purpose

The perception that ECD is very important for the future prospects of children, particularly those from disadvantaged families, has gained attention in recent years and is now widely accepted (Grantham-McGregor et al., 2007; Engle et al., 2007; Victora et al., 2008; Heckman, 2006).

This phenomenon can be at least partly explained by the evidence from developed economies suggesting that human development can be altered in early childhood by effective interventions that change the balance between risk and protection, thereby shifting the odds in favor of more adaptive outcomes. Early childhood development programs that deliver carefully designed interventions with well-defined objectives and that include well-designed evaluation mechanisms have been shown to influence developmental trajectories of children whose well-being is threatened by socioeconomic disadvantages, family disruptions, and disabilities. Programs that combine child-focused educational activities with explicit attention to parent-child interactions and relationship-building appear to have the greatest impact (Shonkoff and Phillips, 2000; Heckman, 2006). However, the effects of ECD programs depend on their specific design and on the characteristics of the affected population (Haveman and Wolfe, 1994; Lamb 1996; Blau and Currie, 2006). Out-of-home ECD services may have positive or negative effects depending on ECD center quality (Love, 2003; Network, 2003; Baydar and Brooks-Gunn, 1991; Currie and Thomas, 1995; Blau, 1999; Duncan, 2003), time spent in child care (Maccoby and Lewis, 2003; Fabes et al., 2003), parental characteristics (Ahnert and Lamb, 2003; Baydar and Brooks-Gunn, 1991; Currie and Thomas, 1995) and the child (Greenspan, 2003; Crockenberg, 2003; Fabes et al., 2003; Currie and Thomas, 1995). The effects of ECD programs are more consistently positive for cognitive outcomes than for non-cognitive outcomes (Dmitrieva, Steinberg, and Belsky, 2007), except among high-quality child-care centers (Sammons et al., 2007).

Recent studies have developed theoretical and empirical models that focus on the role of the family environment, ECD program quality, and child characteristics as inputs in the process of skill/ability acquisition. Cunha et al. (2006), for example, introduce an economic model for the technology of skill formation in which home inputs and children's innate endowments (e.g., genetic factors such as innate abilities or innate health) are directly linked to ECD. Cunha and Heckman (2007) estimate a version of this model, documenting the relative importance of a comprehensive set of variables describing family environments as well as children's cognitive and non-cognitive skills. Heckman, Stixrud, and Urzúa (2006) and Urzúa (2008) provide evidence demonstrating the role of early endowments as determinants of adult outcomes.

Engle et al. (2007) summarize evidence from developing countries. These authors examine effective programs for improving ECD in developing countries based on 19 systematic

studies of ECD programs that met six criteria: (i) randomized controlled trial or matched comparison group; (ii) intervention before age 6 years; (iii) effectiveness or program evaluations (not efficacy trials); (iv) child development assessed; (v) targeted disadvantaged children; and (vi) developing country.[2] Almost all of the evaluations are for introducing new ECD programs on a relatively small scale (only two are national) and with relatively small samples. The estimated effect sizes in cases in which they can be calculated indicate fairly substantial but varying impacts on cognitive skills, ranging from 0.19 to 1.8 standard deviations. The evidence from two of these studies (Bolivia and the Philippines) find important effects of child age at the time of initiation of the exposure (with the largest effects for initiation in the second year of life) and duration of exposure (with relatively large effects for exposure of at least 12-24 months, but diminishing marginal effects thereafter) (Behrman, Cheng, and Todd, 2004; Armecin et al., 2006). The Philippines study also presents evidence of important positive associations between program exposure and family background (Ghuman et al., 2005). Importantly, in this case exposure to ECD programs, however, worsened observed anemia (Armecin et al., 2006), suggesting, for some of the ECD programs evaluated for developed countries, that not all impacts of ECD programs in developing countries are positive.

2.1 Why Chile?

During the last 10 years, Chile has taken serious steps to improve the situation of young children, particularly the most vulnerable, by increasing ECD program coverage to address concerns about equity and quality. In 2001, for example, the Ministry of Education released a publication entitled *Bases Curriculares de la Educación Parvularia* (Curricular Bases for Early Childhood Education), which defined a flexible curricular and pedagogical orientation as well as more than 200 expected learning outcomes to achieve the holistic development of children 0 to 6 years of age (Umayahara, 2006). To improve equity in access, in 2006 Chile launched an early childhood policy initiative called Chile Grows with You, which enabled Chilean children from the poorest families to attend ECD programs (i.e., day care centers and pre-schools) for free.

[2] The studies are Argentina, Berlinski, Galiani and Gertler (2006); Bangladesh, Aboud (2006); Cape Verde, Jaramillo and Tietjen (2002); Colombia, McKay et al. (1978), Pollitt and Escamilla (1996); Guinea, Jaramillo and Tietjen (2002); Myanmar, Save the Children (2004); Nepal, Save the Children (2003); Vietnam, Watanabe et al. (2005); Bangladesh, Aboud (2006); Bolivia, Morenza et al. (2005); Colombia,Waber et al. (1981) and Super et al. (1990); Jamaica, Powell et al. (2004); Jamaica, Powell (2004); Turkey, Kagitcibasi, Sunar and Bekman (2001); Bolivia, Behrman, Cheng and Todd (2004); India,Vazir and Kashinath (1999); Peru, Cuento and Díaz (1999); Philippines, Armecin et al. (2006) and Ghuman et al. (2006); Uganda, Alderman and Engle (2007).

Since 2001, Chile has seen a rapid expansion of ECD programs, which accelerated in2005. Enrollment in public child care centers increased by 240 percent between 2005 and 2007 (Encina and Martínez, 2009; Noboa and Urzúa, 2010). Concomitant with the expansion of ECD programs has been a rapid increase in public resources devoted to such programs. Figures 3A and 3B present the evolution of public resources devoted to ECD programs for children 0-5 years old as a fraction of total public expenditure in education and GDP, respectively. The expansion has been substantial since 1990, with fairly steady growth in the share in GDP but some stagnation between 1996 and 2003 and then acceleration in the share of total public educational expenditures.

Despite the significant expanded effort of the Chilean government, analysis of the Chilean National Socioeconomic Surveys (CASEN) indicates that more than half of children age 5 or younger do not participate in any ECD initiative, and there are considerable inequalities in enrollment rates by family socio-economic status and age (Figures 4A and 4B). For instance, in 1990, children falling in the first and second income quintiles were less than half as likely to access ECD educational services compared with their peer group in the fifth quintile, the wealthiest 20 percent (Umayahara, 2006). By 2006, although the differences in coverage by income quintile had diminished, they had not disappeared, as only 33 percent of children of the first income quintile were covered, compared with 48 percent of the fifth quintile, a difference of nearly 15 percentage points (Figure 4A). Likewise, although the analysis of ECD enrollment rates by age indicates increase over time through 2006, the enrollment rates for children younger than 3 ranged only between 3.5 percent (infants) and 36 percent (3 years old), compared with 63 percent and 87 percent for children age 4 and 5, respectively (Figure 4B).

Disparity in coverage (and its dynamics) is also associated with differences in parental schooling, even after controlling for family income and age of the child. This can be seen in Table 1. In 1990, the average probability of ECD enrollment was 5 percentage points higher for children of mothers with college degrees (relative to a mother with less than high school degree), which is a large differential considering that the average enrollment rate in 1990 was only 16 percent. The association with having a father with a college degree was of similar magnitude. By 2006, the association of maternal schooling with ECD enrollment had become stronger, with the association with having a mother with high school diploma or some post-secondary education more than doubling. Father's schooling, on the contrary, had an unambiguous negative

association with ECD enrollment. Interestingly, the positive (negative) association of mother's (father's) schooling with ECD enrollment became stronger during the period 1990-2006. This is a clear indication of the deep disparities in the ECD system in Chile.

Chile is currently facing the challenge of further expanding coverage while trying to maintain or enhance service quality despite higher costs associated with creating age-appropriate curricula and providing adequate staff training. This is a challenge faced by most other developing countries as well. Thus, careful analysis of the Chilean experience will not only inform Chilean policy, but also policies for other countries in this important area. This paper evaluates the impact of these efforts on child development.

3. Understanding Children's Enrollment in Child Care Centers

Parental decision making about whether to enroll children in a child care center involves a variety of considerations. Among them are the mother's and father's employment status, family structure and environment, and the availability of child care centers. The decision may be also influenced by factors known to the parents but unobserved by the analyst. Examples of these unobserved factors are parents' and children's unobserved abilities.

Our analysis centers on the characterization and modeling of this complex decision. Our data provide the foundations for the empirical implementation of our theoretical choice model. In this way, we can present a complete analysis of the determinants of ECD outcomes (socioeconomic status, family characteristics and availability of ECD services) and study the impact of child care center attendance on short- and medium-term outcomes.

3.1 The Empirical Model

The primary objective of this study is to assess the effects of attending child care centers on early childhood development. This is not an easy task. Without experimental data in which enrollment and attendance at child care centers were exogenously determined, we are forced to examine the potential endogeneity associated with the decision involving "child care enrollment and attendance." We do so by estimating a model with endogenous outcomes and unobserved heterogeneity (Heckman and Vytlacil, 2007; Heckman et al., 2006). In accordance with recent studies, we interpret unobserved heterogeneity as (latent) endowments or abilities (Carneiro et al., 2003; Heckman et al., 2006; Urzúa, 2008).

The outline of the model is as follows:

- The unit of analysis is the household. For simplicity, and given our question of interest, we define a household as two parents and one child.
- At t = 0 parents decide whether or not to enroll their child in a child care center. We assume that the decision depends on parents' observed and unobserved characteristics, as well as on the "availability" of a child care provider. Following the literature on program evaluation, we label those children enrolled and attending child care centers as the "treatment group," and those children not attending child-care centers as the "control group."
- At t = 1, and conditional on the t = 0 decision, outcomes associated with the cognitive and socio-emotional development of children are observed.

As a consequence of the decision made by parents at t = 0, any comparison of outcomes across children experiencing the two regimes (treatment or control) would be subject to qualification. Without further considerations, these comparisons could not be interpreted as indicative of the causal effects of the treatment on child development. This is the standard problem of causal inference (Heckman and Vytlacil, 2007).

As explained in the literature review section, previous studies have dealt with this problem using extensive sets of controls, fixed effect regressions, and instrumental variables. Our approach combines all these previous efforts in a single empirical strategy. This strategy has been used in the literature (Heckman et al., 2006), but this will be the first attempt to apply this methodology in a developing country.

In what follows, we outline our empirical strategy, which is designed to deal with this problem.

3.2 Model of Endogenous Parents' Decisions on Child Care Enrollment

We first introduce the parents' decision choice model. We study the decision of whether or not to send a child to a child care center. We model this binary decision using a latent index structure. Let S_i^* denote the net utility of parents i from choosing to send their child to a child-care center, and D_i a binary variable indicating parents' decision ($D_i = 1$ if child attends child-care center, and $D_i = 0$ otherwise). Thus, we assume:

(1) $$D_i = 1 \text{ if } S_i^* \geq 0,\ D_i = 0 \text{ otherwise.}$$

We assume that net utility S_i^* is determined by observed and unobserved parents' characteristics, and the availability of child care providers. Specifically, we assume

$$S_i^* = \mu_S(Z_i) + V_i$$

where Z_i is a vector of observed characteristics associated with household i, and V_i is an unobserved random variable also affecting utility. (Z_i; V_i) are assumed to be independent. In our empirical implementation of the model, we assume a linear structure for $\mu_S(Z_i)$, i.e., $\mu_S(Z_i) = \gamma Z_i$.

Once parents decide, all children's future outcomes are observed conditional on the decision. Observed and unobserved characteristics drive parents; decision process. Thus, to the extent that these unobserved components correlate with unobservables determining children's future outcomes, we need to control for the potential consequences of selection when comparing outcomes across treatment and control groups. In this study, we focus our analysis on two types of outcomes: cognitive and socio-emotional. We deal with the selection problem by studying models of potential outcomes. We allow the unobserved components determining these outcomes to be correlated across regimes and with parents' decision. As we show below, the intergenerational transmission of abilities generates these correlations. Before discussing the actual mechanism, we introduce the model of potential outcomes.

3.3 Children's Outcomes

Let (Y_{ij}^0, Y_{ij}^1) denote the potential outcomes for child *j* in household *i* corresponding, respectively, to the event of not attending and attending a child care center. Notice that in principle, this notation allows for households with multiple children. However, we first analyze the case of single-child households, and we leave its potential generalization to our future research project.

The model assumes that each of the potential outcomes is determined by the child's observable and unobservable characteristics. Specifically, we write the outcome associated with the treatment state as:

(2) $$Y_{ij}^1 = \mu_1(X_{ij}, U_{ij}^1)$$

and the outcome associated with the control state as:

$$Y_{ij}^0 = \mu_0\left(X_{ij}, U_{ij}^0\right) \tag{3}$$

where X_{ij} is a vector of observed characteristics and $\left(U_{ij}^0, U_{ij}^1\right)$ denotes the unobserved components. X_{ij} might include variables at the child care center level as well. On theoretical grounds, an additive separable structure for $\mu_0\left(X_{ij}, U_{ij}^0\right)$ and $\mu_1\left(X_{ij}, U_{ij}^1\right)$ is not required. However, in our empirical implementation we assume additive separability, i.e., $\mu_0\left(X_{ij}, U_{ij}^0\right) = \beta_0 X_{ij} + U_{ij}^0$ and $\mu_1\left(X_{ij}, U_{ij}^1\right) = \beta_1 X_{ij} + U_{ij}^1$. Notice that we do not impose any assumptions on the correlations between U_{ij}^1, U_{ij}^0, and V_i. We allow the unobserved components from outcomes and parents' choices to be correlated, and as a consequence of this, any comparison of outcomes across schooling groups would be contaminated by the potential selection problem.

Expressions (1), (2), and (3) can be used to define the observed outcome for child *j* from *j* family, Y_{ij}. Observed outcome Y_{ij} can be written as:[3]

$$Y_{ij} = D_i Y_{ij}^1 + \left(1 - D_i\right) Y_{ij}^0.$$

In the event of discrete outcomes, we can follow a similar structure, but assuming a threshold model with a latent linear index determined by observed and unobserved components.

3.4 Intergenerational Transmission of Endowments

The model introduced in the previous section allows for general correlations among unobserved components, namely, V_i, U_{ij}^1, and U_{ij}^0. Formally, we assume:

$$V_i \not\perp U_{ij}^1 \not\perp U_{ij}^0 \,|\left(X_{ij}, Z_i\right),$$

where $A \not\perp B \,|\, C$ denotes "A and B are not independent conditional on C". In what follows, we analyze the underlying structure causing the error terms to be correlated.

We model the general correlations in unobserved components by assuming that the error terms are governed by a factor structure which we interpret as unobserved endowments (see

[3] This is the Neyman (1923) - Fisher (1935) - Cox (1958) - Rubin (1974) model of potential outcomes. It is also the switching regression model of Quandt (1972) or the Roy model of income distribution (Roy,1951; Heckman and Honoré, 1990).

Cunha and Heckman, 2008, Heckman et al., 2006, and Urzúa, 2008, for empirical studies using the same strategy). That is, we posit the existence of a vector of latent endowments, which, as we discuss below, includes cognitive and socio-emotional endowments. Specifically, if we denote by θ_i the unobserved endowments from household/parents i, we assume

$$V_i = \alpha_V \theta_i + \upsilon_{iV}$$

where $\upsilon_{iV} \perp \theta_i$. Therefore, parents' decision of whether or not to enroll their children into a child-care center depends on the household-specific unobserved endowments (as well as observed characteristics). On the other hand, child's unobserved components U_{ij}^0 and U_{ij}^1 are assumed to be determined by child's unobserved endowments θ_{ij}, i.e.:

$$U_{ij}^0 = \alpha^0 \theta_{ij} + \upsilon_{ij}^0$$
$$U_{ij}^1 = \alpha^1 \theta_{ij} + + \upsilon_{ij}^1$$

where $\theta_{ij} \perp \upsilon_{ijV}^0 \perp \upsilon_{ijV}^1$. Finally, we assume the following equation for the intergenerational transmission of equality:

$$\theta_{ij} = \lambda \theta_i + \xi_{ij}$$

Therefore, we assume child's ability is determined by parent's endowment θ_i, and ξ_{ij} which represents an individual idiosyncratic component which is assumed independent from θ_i.

Using this structure, we can analyze the importance of unobserved abilities as determinants of children's outcomes. Additionally, since we fully model the decision problem faced by parents, we can control for the endogenous selection process, and consequently, we can study the effect of attending a child care center on ECD.

As we describe next, in order to identify this model we must supplement it with additional information.

3.5 Measurement System as Identification Device

Following Carneiro, Hansen, and Heckman (2003) and Heckman, Stixrud, and Urzúa (2006), we posit a linear measurement system to first identify the distribution of the unobserved endowments θ_i. We supplement the model introduced above with a set of equations linking

parents' characteristics (cognitive and socio-emotional variables) with our unobserved endowments. These equations allow the interpretation of unobserved θ_i as a combination of cognitive and socio-emotional endowments. Specifically, if we denote by M_C, M_S the set of parents' cognitive and socio-emotional variables, and omit the sub-index *i* for a better exposition, we assume:

$$\begin{aligned} M_{C1} &= \delta_{C1} X + \alpha_{C1}\theta + \upsilon_{C1} \\ &\vdots \\ M_{CN_C} &= \delta_{CN_C} X + \alpha_{CN_C}\theta + \upsilon_{CN_C} \\ M_{S1} &= \delta_{S1} X + \alpha_{S1}\theta + \upsilon_{S1} \\ &\vdots \\ M_{SN_S} &= \delta_{SN_S} X + \alpha_{SN_S}\theta + \upsilon_{SN_S} \end{aligned}$$

where X denotes the set of observed characteristics determining the measures, we that assume $\upsilon_{C1} \perp \ldots \perp \upsilon_{CN_C} \perp \upsilon_{S1} \perp \ldots \perp \upsilon_{SN_S}$, and N_C and N_S denote the number of cognitive and socio-emotional outcomes available, respectively. In order to secure the identification of the model, we require $N_C + N_S > 2$. Finally, since there are no natural units for latent endowments, for some M_{Ck}, or M_{Sk}, we set $\alpha_{Ck} = 1$ or $\alpha_{Sk} = 1$. Under these restrictions, we can show that the distribution of θ_i and all the parameters in the measurement system are identified (see Carneiro, Hansen, and Heckman, 2003, for a detailed analysis of the non-parametric identification of this model).

Once the distribution of parents' endowments θ_i is secured, we can control for the selection into child care centers, and consequently, we can estimate the models of potential outcomes $\left(Y_{ij}^0, Y_{ij}^1\right)$. More precisely, we can write the potential outcome equations as:

$$\begin{aligned} Y_{ij}^0 &= \beta^0 X + \alpha^0 \lambda \theta_i + \alpha^0 \xi_{ij} + \upsilon_{ij}^0 = \beta^0 X + \tilde{\alpha}^0 \theta_i + \tilde{\upsilon}_{ij}^0 \\ Y_{ij}^1 &= \beta^1 X + \alpha^1 \lambda \theta_i + \alpha^1 \xi_{ij} + \upsilon_{ij}^1 = \beta^1 X + \tilde{\alpha}^1 \theta_i + \tilde{\upsilon}_{ij}^1 \end{aligned}$$

Thus, after identifying the distribution of θ_i we can control for the unobserved abilities and obtain $\tilde{\alpha}^0$ and $\tilde{\alpha}^1$. Notice that without further assumptions we cannot identify λ. However, the

identification (and estimation) of this parameter does not affect the results of the effects of attending child care center.

Therefore, we can identify the key ingredients of our model of endogenous decision and unobserved endowments. With these in hand, we can analyze the impact of child care centers on children's outcomes.

Finally, although we have used a single outcome to illustrate the logic behind our approach $\left(Y_{ij}\right)$, our empirical analysis will be carried out on a variety of outcomes including cognitive and socio-emotional development and health outcomes of children. We discuss the specific outcomes below.

3.6 Defining the Effects of Child Care Centers

This section explains how the structure of our model of parental endogenous decisions can be used to analyze the effects of child care centers on early childhood development.

To begin, notice that the presence of unobserved heterogeneity and the endogenous selection process prevent us from interpreting the results from regressions of outcomes on child care attendance as "the child care center effect." This applies to both OLS and IV regressions (Heckman, Urzua, and Vytlacil, 2006; Imbens and Angrist, 1994). In this study, we propose a different approach. We use our model to generate mean treatment parameters and distributions of treatment parameters from a common set of semi-structural parameters.

Let $\Delta_{ij} = Y_{ij}^1 - Y_{ij}^0$ denote the individual-specific treatment effect for a given child *j* in household *i* and outcome Y. Clearly, Δ_{ij} involves factual and counterfactual regimes: for a given child, it involves the outcomes under both regimes, although only one of them is observed.

Since our model deals with the estimation of counterfactual outcomes, we can use its structure to generate distributions of individual-specific treatment effects. With this distribution in hand, we can compute different treatment parameters.

In what follows we omit sub-indexes *i* and *j* for simplicity. Furthermore, without loss of generality, throughout this section we denote by Y and X any outcome variable and its associated covariates.

The first parameter that we consider is the average effect of the treatment on a child drawn randomly from the population of individuals. The average treatment effect is:

$$\Delta^{ATE} = \iint E\left(Y^1 - Y^0 \mid X = x, \theta = t\right) dF_{X,\theta}\left(x,t\right),$$

where we integrate $E\left(Y^1 - Y^0 \mid X = x, \theta = t\right)$ (the average treatment effect given $X = x$ and $\theta = t$) with respect to the distribution of X and θ.

The second parameter that we consider is the average effect of the treatment on the treated, i.e., on a person drawn randomly from the population of individuals who entered the treatment:

$$\Delta^{TT} = \iint E\left(Y^1 - Y^0 \mid X = x, \theta = t, D = 1\right) dF_{X,\theta|D=1}\left(x,t\right).$$

This parameter informs about the average gains among those children attending child-care centers. A negative Δ^{TT} would imply a negative effect of child-care centers for those children "treated." In this sense, Δ^{TT} is the relevant parameter from the point of view of the policymaker.

We complement Δ^{TT} and Δ^{ATE} with two extra parameters: the treatment effect on the untreated and the average marginal treatment effect:

$$\Delta^{TUT} = \iint E[Y^1 - Y^0 \mid X = x, \theta = t, D = 0) dF_{x,\theta|D=0}(x,t)$$
$$\Delta^{AMTE} = \iint E[Y^1 - Y^0 \mid X = x, \theta = t, S^* = 0) dF_{x,\theta|S^*=0}(x,t)$$

4. The Data and Empirical Implementation

A critical limitation for the analysis of early child development in developing countries, and Chile in particular, is the absence of detailed information on family environment, parental background, child assessment, and child care center characteristics. We deal with this issue by administering a new survey containing the necessary information to understand, in the context of our theoretical framework, the variables influencing parents' decisions about the use of child care centers and the variables determining children's cognitive, socio-emotional, and health outcomes.

Our sample contains rich information for a representative sample of 650 children between 0 and 5 years of age from Santiago, Chile's capital city. We collected information on dimensions such as education, occupational status, income, assets, and health status for all members of each child's household, which provided data on 3,242 individuals. In addition, for

mothers and children we collected a variety of different cognitive and socio-emotional test scores. We also recorded the mothers' employment histories and the children's enrollment in child care centers.

We complemented our data with historical records (based on administrative data) of the number and location of child care centers in each municipality of Santiago. This allowed us to generate the shortest distance from each household's address to any of the centers in Santiago. We use this variable as a measure of the availability of ECD centers at the household level.

Finally, also using administrative sources, we generated a measure of municipal capacity of public ECD centers. For each municipality and for each month starting in March 2001, we calculated the average number of children per public ECD center within the municipality. We then added this new variable to our individual data. We merged the information based on the child's month and year of birth. In this way, we controlled for the local supply of child care centers at the time the children were born.

In summary, we used a new survey and multiple sources of administrative data to present a complete analysis of the determinants of ECD outcomes (socioeconomic status, family characteristics, and availability of ECD services) and to study the impact of child care center attendance on short and medium-term outcomes. In the following section, we describe the structure of the new survey.

4.1 Description of New Survey

Between August and October, 2009, in collaboration with the Centro de Microdatos of the University of Chile, we collected information on 650 children and their families. The sample is representative of children in Santiago. Our sample of 650 children includes individuals born between 2004 and 2009. Table 2 presents the distribution of dates of birth of the 650 children in our sample. Following is a description of the information included in the survey.

Module A. Household Composition: This module collects the most important socio-economic characteristics of the members of the household, including age, gender, and relationship with selected child, among others. Within each household we identify a "selected" child.

Module B. Education: This module collects information on the highest level of schooling of each member of the household, as well as information on the characteristics of the schools in which they were enrolled. It also asks for each family member's evaluation of ECD centers.

Module C. Health: This module collects information from interviewee (usually child's mother or guardian) and his/her spouse. It also collects data on access to health system.

Module D. Employment Status: This module collects information from the interviewee (usually child's mother or guardian) and his/her spouse. It collects detailed information on the occupational status and job characteristics.

Module E. Income: This module collects information from the interviewee (usually child's mother or guardian) and his/her spouse. The module collects information on income and salary for each member. The module also includes information about subsidies.

Module F. House Conditions: This module asks for a description of the child's home.

Module G. Pregnancy: This module collects information on the mother's health status during pregnancy (with the selected child) as well as on the characteristics of the delivery and newborn's health. It asks whether the mother had health problems during pregnancy; whether the mother had emotional difficulties during the pregnancy; the type of delivery (normal, Cesarean, other); complications during delivery; whether the child was born premature (and if so, by how many weeks); how long did the child spend in an incubator; the child's birth height and weight; Apgar score; whether the child was breastfed soon after birth; if not, why not; the number of months the child was breastfed; whether a nutritional supplement was necessary in first six months; what supplement was requested by the pediatrician; whether the child regularly sees a pediatrician; the child's most common illnesses; whether child experienced any trauma; and any history of illness in the family.

Module H. Child care: The information in this module is collected by child's age. We consider the following ranges: 0-3 months, 3-6 months, 6-12 months, 12-18 months, 18-24 months, 2-3 years, 3-4 years and 4-5 years. For each age range we collect data on access to child day care and mother's employment.

Module I. Activities and Presence of Toys in the Home: This module collects information on the educational resources available within the household. It also asks for information on nutrition and access to public program.

Module J. Vaccinations: Information is collected from the child's vaccination card.

Parental and Family Background: This module collects data on whether the child lives with biological father, stepfather, or neither; father's age; mother's age; father's employment; mother's employment; father's income; mother's income; father's education; mother's education; and number of siblings.

Table 3 presents a summary of the statistics for the family background variables. These variables are used as covariates in the context of the empirical models described below. The minimum distance is measured using geo-references of the households and child care centers. The average number of children per center comes from a child care center dataset for the Santiago area, and is the average taken at the municipality level.

Additionally, for each selected child and his/her mother we collect information in the areas listed below.

*Child's Background**:*** Child's height and weight at birth; Apgar score; whether the child was breastfed soon after birth; if not, why not; number of months that the child was breastfed; nutritional supplement necessary in first six months; what supplement was requested by pediatrician; whether the child regularly sees a pediatrician; the most common illnesses of child; whether the child experienced trauma; and any history of illness in the family.

Child's Assessments:

- **Cognitive Instruments.** EEDP: motor skills (0-24 months), TEPSI: motor skills (2-5 years), PPVT: vocabulary (2.5-6 years), Backward Word Span: memory (3-6 years).[4]
- **Social-Emotional Instruments.** Ages and Stages questionnaires and the Child Behavior Checklist (1.5-5 years); Behavior Assessment Questionnaires (IBQ 3-12 months / ECBQ 18-36 months / CBQ 3-7 years).[5]

[4] EEDP: This test measures the child's reaction to certain situations for which a certain level of psychomotor development is required. TEPSI: This test has three subscales which measure the following: coordination, language, and motor functions. PPVT: vocabulary test which measure the child's comprehension and understanding of vocabulary by relating words to an illustration.

Figure 4 presents the list of age-specific cognitive and socio-emotional tests utilized in this study, as well as a list of the health variables.[6] Table 4 gives the number of children that were administered each test. Because of time constraints, it was not possible to administer all of the age-appropriate evaluations to every child. The households were randomly split into two groups, and if there was more than one cognitive or socio-emotional test, then half of the children were given one test and the other half the other. For example, 123 children were given the CBCL and TEPSI tests, and 121 were given the PPVT and CBQ tests. Table 5 shows the summary statistics for the children's assessments.

Mother's assessments:

- **Cognitive Instruments.** Wechsler Adult Intelligence Scale-Revised (WAIS-R): IQ Scale tests are the primary clinical instruments used to measure adult and adolescent intelligence. Only the subtests for vocabulary and working memory were used in this survey.[7]
- **Socio-emotional Instruments.** The Big Five personality traits are five broad domains or dimensions which are used to describe human personality. The Big Five factors are Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism.[8]

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[5] ASQ:SE are screening tests which help identify possible problems in social and affective development. It measures the following seven different areas of development: self-regulation, obedience, communication, adaptation, autonomy, emotional health, and social interaction.
CBCL. This test evaluates the child's behavior and emotional problems in the age range of one and a half years to five years. It is often thought of as a tool to identify potential emotional problems of the child, suggest possible evaluations, and plan for possible interventions. IBQ, EBQ, CBQ: All of these measure different dimensions of temperament. Subtests for CBQ: 1. Surgency: activity level, high-intensity pleasure, impulsivity, extroversion. 2. Negative Affectivity: anger, discomfort, fear, sadness. 3. Effortful Control: attention focusing, inhibitory control, low-intensity pleasure, perceptual sensitivity.

[6] In order to evaluate the use of each of the test scores, we carried out focus groups with the team of psychologists who helped us during the interviews. Table A1 presents a summary of the evaluations for each test.

[7] WAIS Test. Test consists of 3 subscales which measure the following:
1. Digit Memory: Ability to recall digits from memory, performance based on the maximum length of a list of digits the subject can recall.
2. Reverse Digit Memory: Similar to Digit Memory subtest but rather measures the subject's ability to recall list of digits in the reverse order, performance is based on the maximum length of the reverse list of digits recalled.
3. Vocabulary: Subtest which measures the subject's knowledge of word meaning.

[8] Big Five Inventory. Test consists of 5 subscales which measure the following:
1. Extroversion: energy, positive emotions, sense of urgency, outgoing and social attitudes.
2. Agreeableness: tendency to be understanding and cooperative rather than being suspicious or shunning contact with others.
3. Conscientiousness: tendency to show self-discipline, work diligently, and planning ahead of time to meet goals rather than act on impulses.

Table 6 presents the summary statistics for the mother's assessments.

Child care, pre-school and/or school environment. Current school level attended; characteristics of child's school, pre-school or child care center (including address); level of satisfaction with the institution; usual activities between school and dinner. If child goes home after school, is an adult usually present? Is the child a member of any clubs, teams, or school activities in/out of the institution? Usual summer activities. Does the child feel safe in neighborhood? Amount of time spent watching TV on weekdays and on weekends.

Figure 5 shows enrollment by age. Enrollment does not reach 10 percent until the children are one year old. At two years old, a little less than a third of children are enrolled in child care centers. At three and four years old, enrollment in child care reaches about 55 percent and 70 percent, respectively. Enrollment is disaggregated into the various categories of centers in Tables 7 and 8. Municipal, JUNJI, and INTEGRA are public child care programs, while Particular and Relative's workplace are private. Private child care centers capture about 20 percent of the market for children at least one year old. Private child care centers appear to play a larger role for younger children, but there are not enough observations to determine whether this is significant.

4.2 Identification and Estimation of the Structural Model

As previously mentioned, the identification of the model introduced in Section 3 follows from the analysis in Carneiro, Hansen, and Heckman (2003) and Heckman, Stixrud, and Urzua (2006). This approach relies on two normalizations, which are discussed below.

The estimation of the model is implemented using a maximum likelihood approach. Our likelihood function includes the mother's cognitive and socio-emotional test scores, the child's enrollment status, and the child's cognitive and socio-emotional test scores. We assume that bi-joint distribution of unobserved cognitive and socio-emotional ability is normal with mean zero and non-diagonal variance/covariance matrix. The values for the two variances and the covariance are obtained as part of the estimation.

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4. Neuroticism: tendency to experience emotions such as anger, anxiety, depression, vulnerability; resembles emotional instability.
5. Openness: Appreciation for the arts, emotions, adventures, unusual ideas, curiosity, and a certain variety in experiences.

5. Main Results

In order to provide a comprehensive analysis, we present our analysis in three sub-sections. First, we analyzed the correlation between mother and child's cognitive and socio-emotional variables. This evidence helps to identify the critical periods of child development and the cognitive and socio-emotional measures presented in the two subsequent sections.

Second, we estimated the demand for out-of-home child care services using a standard binary decision model. We showed how distance between home and an ECD center, the average capacity of the centers at the local level, and socio-economic variables at the household level determine the demand. We then examined the effects of attending ECD centers using standard regression models. We studied children's cognitive, socio-emotional, and health outcomes. We estimated the effects using OLS and instrumental variables. The instruments used were determined by our results from the estimation of the demand.

Finally, after presenting the results from the strategy in its reduced form, we analyzed the demand for ECD centers and their effects on child's development using the structural model introduced in Section 3.

5.1 Mother's and Children's Test Scores

Table 9 presents the correlation of the mother's and the children's cognitive tests for children aged two and younger. The sign of the correlation depends on the test considered for the mother. The correlations are not statistically significant.

Table 10 presents the correlations of mother's and children's socio-emotional tests again for children aged two and younger. The only significant correlations are between mother's openness to experience (an attribute that is part of the Big Five taxonomy) and children's Surgency and Control (both sub-scales of EBQ).

Tables 11 and 12 present the correlation between mother's cognitive abilities and children's social-emotional tests and between mothers' socio-emotional test scores and children's cognitive tests, respectively (also age two and younger). As with Tables 9 and 10, only a limited number of correlations are statistically significant, and no clear patterns emerge from these tables. The same result is obtained after examining the correlations between children's cognitive and social-emotional scores (Table 13).

Thus, we interpret the evidence from Tables 9-13 as the manifestation of the scant information contained in cognitive and socio-emotional measures before age two.

Tables 14 and 15 present the correlations between the mother's and the children's cognitive and socio-emotional test scores, respectively. The correlation between mother's verbal IQ and both TEPSI and PPVT scores are positive and statistically significant (see Table 13). Extroversion, conscientiousness, neuroticism, and openness to experience show significant correlations with CBQ and CBCL.

The analysis of the correlations between mother's cognitive and children's socio-emotional suggests a non-significant connection (Table 16). This is consistent with what we obtain for children younger than two years of age (Table 11). However, for older children there are significant correlations between mother's social-emotional and children's cognitive tests (Table 17). In particular, mother's extroversion and openness to experience are positively correlated with TEPSI and PPVT.

Table 18 presents the correlation between cognitive and social-emotional tests for children older than two. The results are the opposite of those observed in Table 13. The signs of the correlations are consistent with what one would expect, and most of them are statistically significant.

Finally, Table 19 presents the correlation between mother's cognitive and social-emotional test scores. There are significant correlations between measures of IQ and the Big Five personality traits. All the signs are the expected.

The analysis of our evidence suggests that only the tests applied after age two provide information about the connection between mother's and children's cognitive and social-emotional variables. Therefore, the analysis that follows is restricted to the sample of older children.

5.2 Reduced Form Results

5.2.1 The Demand for Child Care Services

We first examined the determinants of the demand for child care using standard choice models. Table 20 presents the estimated marginal effects from a set of probit models of children's attendance on individual's characteristics (Model 1), socio-economic background (Model 2), mother's cognitive and socio-emotional tests (Model 3), distance from home to closest child

care center (Model 4), and the average number of children per center at the local (municipality) level (Model 5). Consistent with the results discussed in Section 2, we found that children's age increases the probability of attendance, whereas total number of family members in the household reduces this probability. The mother's numerical IQ and extroversion increase the chances of enrollment. Finally, distance to child care center and our proxy for local capacity have significant and negative effects on the probability of attendance.

5.2.2 The Effects of Attending Child Care Centers

We now estimate the effect of attendance at a child care center using linear regression models. Theoretically, we can interpret our results as an approach to the production function of cognitive and socio-emotional abilities of children, measured (proxied) by different cognitive and socio-emotional tests (Todd and Wolpin, 2003). We also present results for three health measures: height, weight, and BMI. All of these variables are measured at the time of the interview.

The variable of interest is defined as 1 if the child has attended a child care center between the age of birth and the age of the interview, 0 otherwise. Here we address the endogenous selection into child care centers using an instrumental variable approach. We use as instruments the distance from home to the closest child care center and our measure of local capacity (average number of children per center at the municipality level). Our identification strategy then relies on the assumption that these two variables do not have a direct effect on the child's performance on the different tests.

Table 21 presents the results for TEPSI. The OLS results suggest a positive and significant impact of attendance on coordination (0.19 std. deviation), language (0.18 std. deviations), and overall score (0.17 std. deviation). The IV results confirm the sign of the effect, but the estimate is not statistically significant. Interestingly, in general, gender (female=1) and age have positive and significant effects on TEPSI, as well as mother's extroversion. The results also suggest that father's years of education and mother's numerical IQ score have positive effects on a child's cognitive development.

Table 22 presents the results for our second measures of cognitive development, PPVT. In this case we do not find evidence of significant effects of attendance, although the magnitude of the OLS estimate is similar to what we found in Table 20 (0.156 std. deviations).

Table 23 presents the results for CBCL, our first measure of socio-emotional ability. Attendance at a child care center has no effect on socio-emotional development, although the sign is the expected (negative). Mother's education, mother's IQ (verbal), and mother's conscientiousness are significant predictors of CBCL. In particular, we estimate that one standard deviation change in mother's conscientiousness translates into 0.2 standard deviation improvement in children's CBCL.

Table 24 shows the estimates associated with CBQ and its sub-scales. We obtain a significant and negative effect of attendance on surgency (a positive effect of enrollment). Mother's conscientiousness appears again as a significant predictor of the child's socio-emotional development.

Finally, Table 25 presents our results for children's height, weight, and BMI. Age (as expected) appears as the only variable determining these variables. Only for weight (OLS) do we find a significant effect of mother's conscientiousness. We estimate that one standard deviation change in conscientiousness increases weight by 0.230 grams.

5.3 Results from Structural Model

The choice of the unobserved abilities is motivated by the reduced form results. In the reduced form results, we identify mother's cognitive abilities and extroversion as the two most significant and robust measures of cognitive and socio-emotional abilities, respectively. Thus, we posit the existence of two unobserved abilities, one linked to cognition and the other linked to the mother's extroversion.

The model is estimated in two stages. First, the distribution of the abilities is measured from two dedicated measures. The cognitive abilities are measured using the three WAIS sub-tests: digits, reverse digits and vocabulary. The socio-emotional abilities are measured from the eight questions in the Big Five taxonomy dedicated to extroversion. This set of 11 equations represents the measurement system, the source of the identification for the distribution of unobserved abilities.

In the second stage, the models for the child care decision and child's outcomes are estimated using the estimates from the first stage. In most cases, the significant covariates in the reduced form results have the same sign and are significant in the model, as would be expected.

5.3.1 The Distribution of Unobserved Abilities

Table 26 shows the estimates associated with distribution of unobserved abilities. (Recall that we assume a bivariate normal distribution for the joint distribution of the two unobserved factors.) Interestingly, although we allow unobserved cognitive and socio-emotional abilities to be freely correlated; our results suggest that the correlation is small, positive, and non-statistically significant.

5.3.2 Results from the Measurement System (Mothers).

Table 27A and 27B show the results for the cognitive and socio-emotional items of the measurement system, respectively. Notice that we assume a system of fully dedicated measures, that is, cognitive ability affects only cognitive test scores and socio-emotional ability affects only socio-emotional test scores. Furthermore, we impose the loadings' normalizations securing the identification of our model on reverse digit (IQ-WAIS) and *I tends to be quiet* (Extroversion-Q21). The results show the significant effects of both unobserved factors. Cognitive and socio-emotional abilities are strong determinants of measured cognitive and socio-emotional test scores, respectively. With respect to the observable variables, mother's age and schooling level are significant determinants of each of the cognitive tests in WAIS. Only mother's education predicts the extroversion.

5.3.3 The Demand for Child Care Services

Table 28 shows the results for the model for attendance at a child care center. This can be compared to Table 20 in the reduced form results. The coefficients associated with the number of individuals in the household and child's age are significant. They also have the same signs as in our reduced form model (probit). Likewise, both of the mother's abilities have positive loadings, but only extroversion is significant in the full model. The model can be simulated, and we can look at the distribution of mother's abilities for mothers who send their children to child care and those that do not. Figure 6 shows the sorting by ability. Although the sorting is not strong, we can see a difference in the distributions, where children who go to child care have mothers of higher ability.

5.3.4 The Effects of Attending Child Care Centers

Tables 29, 30, and 31 display the results for TEPSI, CBCL, and CBQ evaluations, respectively. They can likewise be compared to Tables 21, 23, and 24 in the reduced form results. Here the models are estimated separately for those who attend child care and those who do not. It is interesting in the case of the TEPSI that the loadings on the factors are larger and more significant for the parents who send their children to child care compared to those who do not. The effect can be clearly seen when comparing Figures 7 and 8. These figures show the average standardized TEPSI score for children with mothers of different ability. The abilities of the mother are split into deciles of cognitive and socio-emotional ability. Figure 7 shows the average TEPSI score for the children that stay at home, while Figure 8 shows the average TEPSI score for children that go to child care. Figure 7 shows a very clear upward slope, where children with parents of higher ability do much better on the evaluation. This effect is not seen for the children who stay at home. This could be the effect of mothers trying to compensate for sending their children to child care, who end up spending more quality time with them than mothers who stay at home.

The socio-emotional evaluations CBCL do not seem to depend on the mother's abilities. CBQ on the other hand has two dimensions that significantly depend on both of the mother's abilities. The mother's cognitive ability seems to have a negative effect on the child's surgency and negative affect. It is possible that mothers with higher cognitive ability are better at encouraging behavior regulation in children, making them less impulsive and less likely to outwardly express anger and fear. On other hand, surgency and negative affect are positively related to the mother's extroversion. It is easy to see how a mother with higher extroversion might encourage her children to be more impulsive and outgoing. The positive dependence with negative affect is harder to see, but it may be that a very extroversive mother might over-stimulate her child, which could lead the child to feel discomfort, fear, and anger.

Table 32 presents the results for the children's physical tests. With the exception of age, we do not find robust determinants of children's weight or height. Only in one case, mother's socio-emotional ability, is it statistically significant (height for homecare).

Finally, table 33 displays our estimates of the treatment effects of sending children to child care versus the alternative of homecare. We observe positive effects on cognitive development. In particular, our evidence shows a significant effect on TEPSI regardless of the

treatment parameter considered. Furthermore, our evidence suggests that children with parents at the margin of indifference might show larger effects on cognitive development than the average child. The results for socio-emotional and health indicate ambiguous effects. This should not be interpreted as a failure or negative effects of attending child care centers. It might simply illustrate the complications associated with identifying robust treatment effects in areas that are hard to evaluate or measure using small samples.

6. Conclusions

This paper presents a comprehensive empirical analysis of the impact of attending a child day care center (or pre-school) on early childhood development (ECD) in the context of Chile. We examine child development from a multi-dimensional perspective, taking into account the equally multi-dimensional characteristics of parents and the availability of child day care providers. We also address the potential endogeneity associated with the parental decision of sending children to pre-schools. The empirical analysis is carried out using new data from Chile, specifically designed to characterize child development. The new household survey contains rich information on cognitive and socio-emotional traits for young children, family environment (including parents' cognitive and socio-emotional traits), child-care enrollment, and the availability of out-of-home care services.

Our results suggest the following:

1. Cognitive and socio-emotional test scores from children younger than two are too noisy to be analyzed.
2. When analyzing enrollment in child care centers for children older than two, there are significant effects of family background, unobserved abilities, the local availability of centers, and local capacity.
3. Enrollment in child care centers seems to boost child cognitive development among children older than two, even after controlling for selection.

These results provide new evidence on key elements associated with public policies designed to promote child development. Better data and better tools for evaluating child development will enhance our knowledge and ability to develop and design more efficient public policies.

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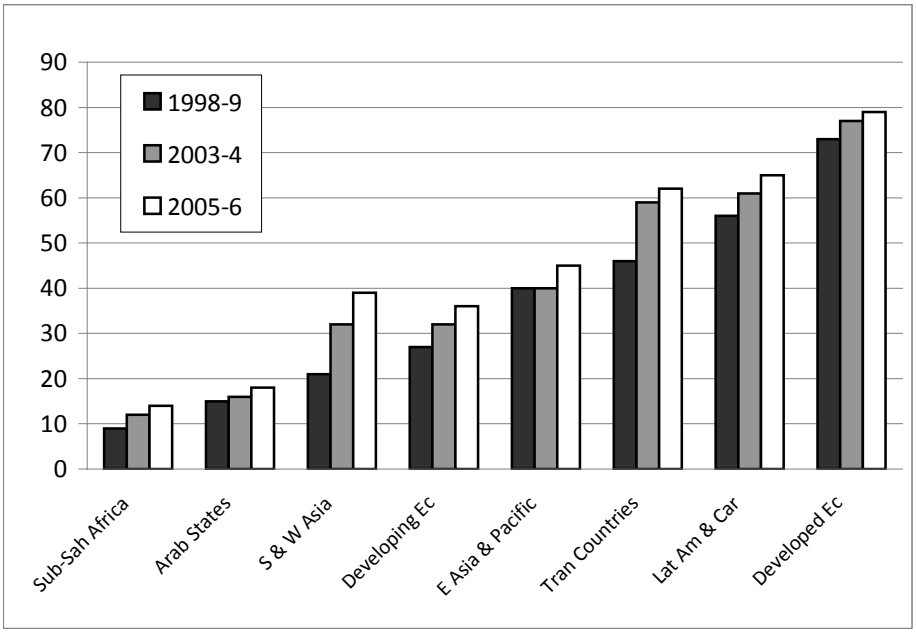
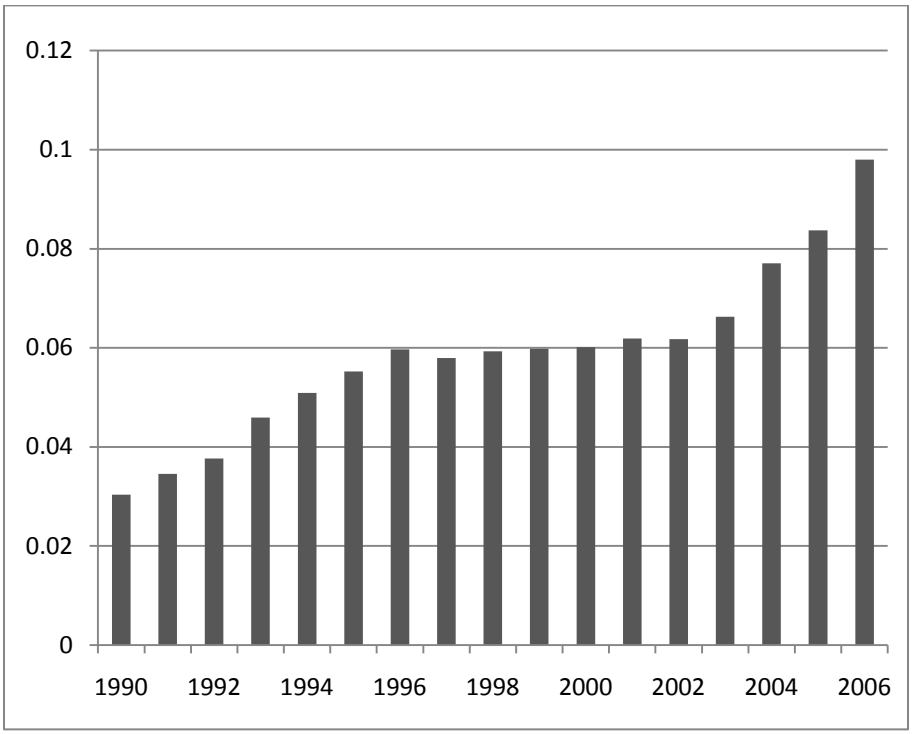
Figure 1. Early Childhood Gross Enrollment Rates (%)



Source: Engle at al. (2007).

Figure 2. Public Resources Devoted to ECD Programs

2A. As % of Total Public Expenditure in Education



2B As % of Gross Domestic Product

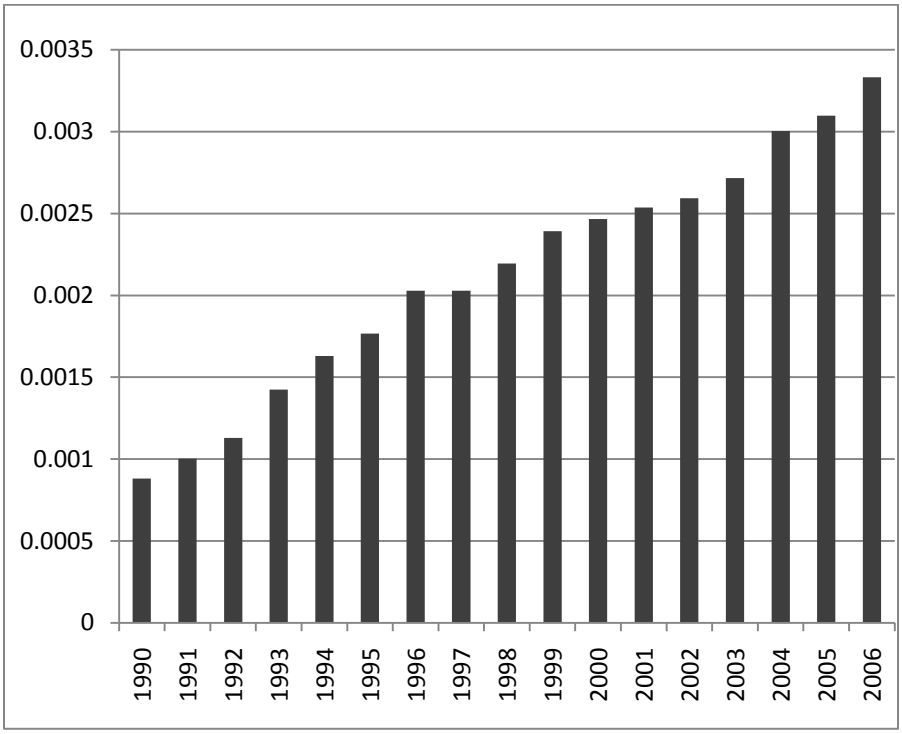
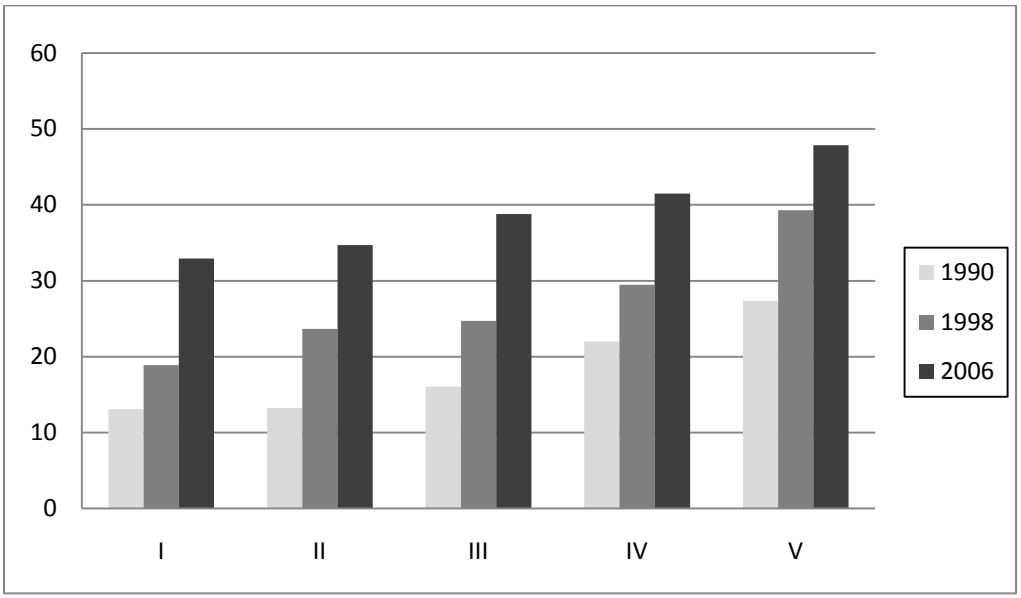


Figure 3. ECD % Enrollment

3A. Enrollment by Income Quintiles



3B. Enrollment by Age

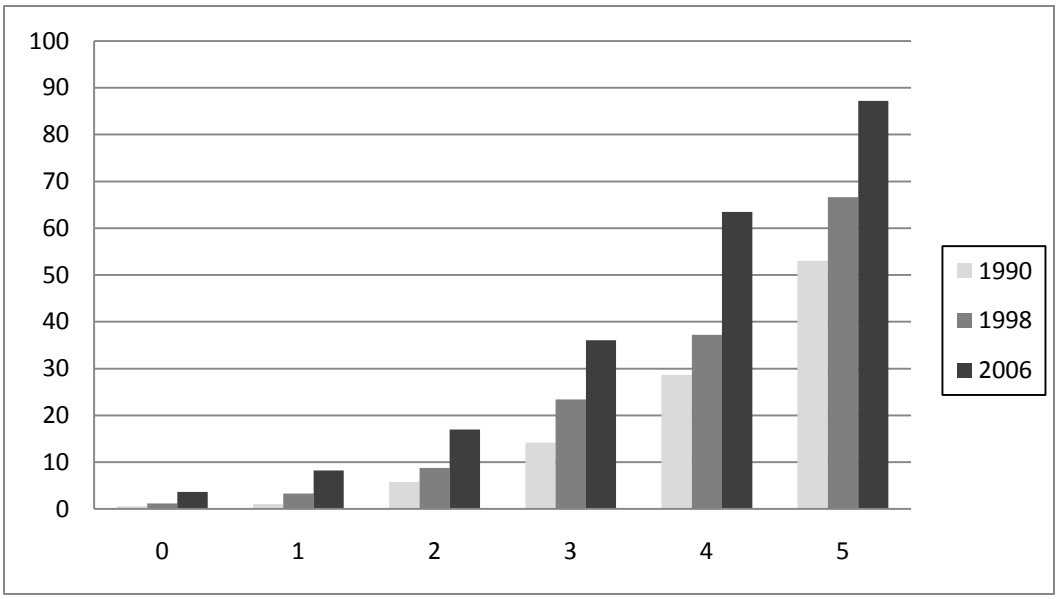


Figure 4. Age-Specific Cognitive, Socio-emotional and Physical Tests

Children		Months									
Area	**Test**	**6**	**12**	**13**	**17**	**18**	**23**	**24**	**35**	**36**	**60**
Cognitive	EEDP										
	TEPSI										
	BWS										
	PPVT										
	HTKS										
Socio-Emotional	ASQ: SE										
	CBCL										
	IBQ										
	EBQ										
	CBQ										
Physical	Weight										
	Height										
	Crane Circumference										

Figure 5. Enrollment Rates by Age

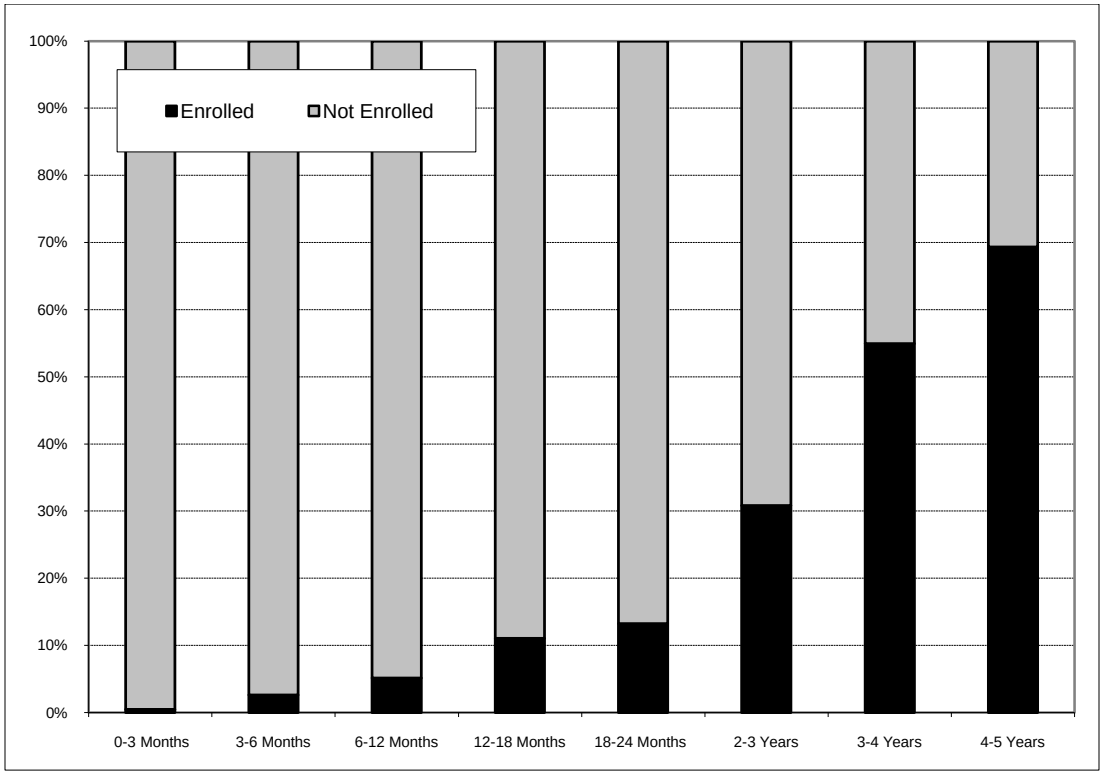


Figure 6. Sorting into Child Care Center
Distributions of Unobserved Cognitive and Socio-emotional by Enrollment Status

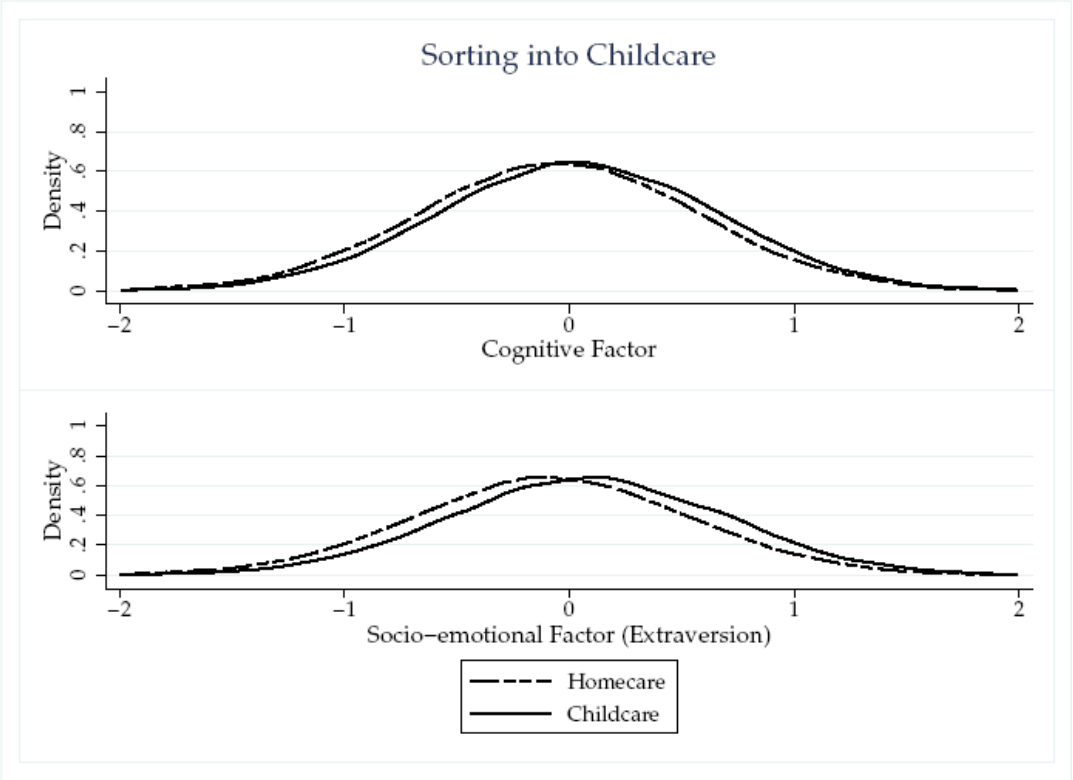


Figure 7. Average TEPSI score for Children that Stay at Home (Control Group) as a Function of Mother's Cognitive and Socio-emotional Unobserved Abilities

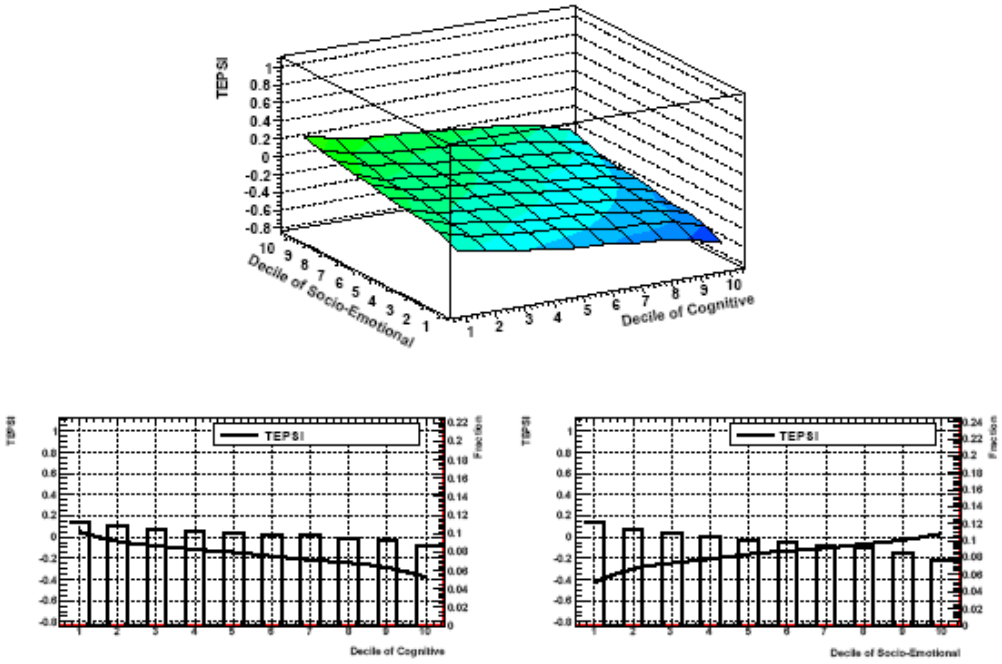


Figure 8. Average TEPSI Score for Children Enrolled in Child Care (Treatment Group) as a Function of Mother's Cognitive and Socio-emotional Unobserved Abilities

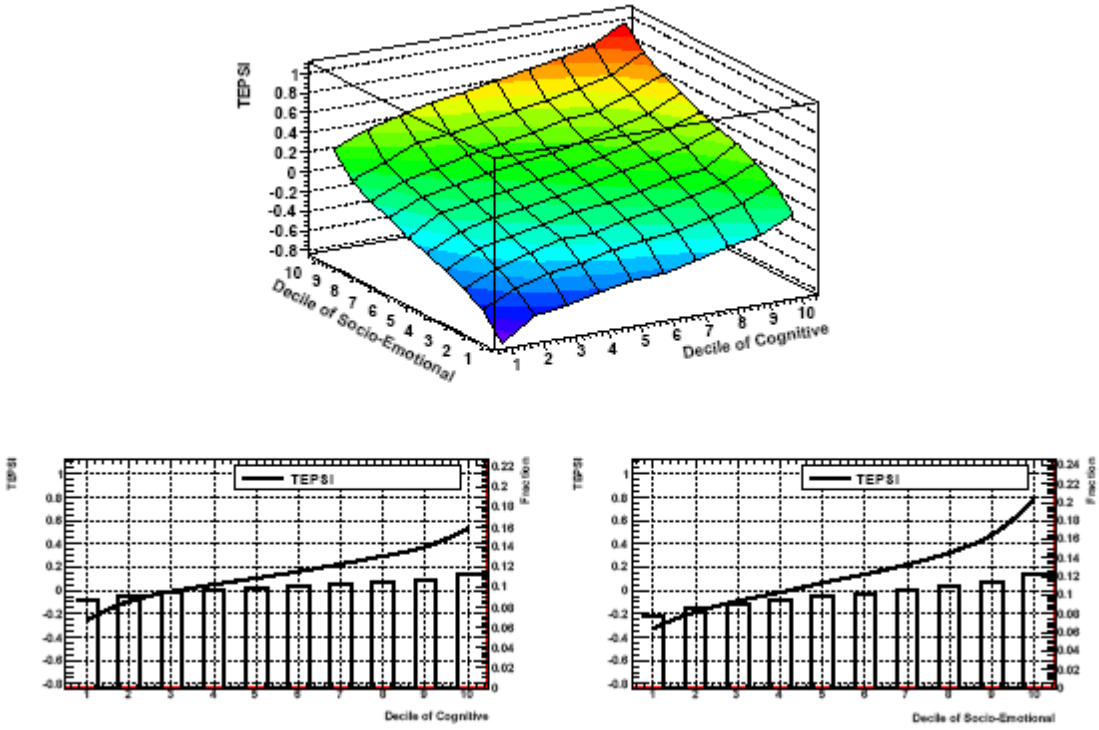


Table 1. Determinants of Enrollment in ECD Centers Children 0-5 Years of Age, CASENs 1990-2000

Variable	1990	2006	Difference 2006-2001
Father has HS Degree	-0.004	-0.02	-0.02
Father has Some College	-0.002	-0.02	-0.02
Father has College Degree	0.04	-0.03	-0.08
Mother has HS Degree	0.01	0.04	0.03
Mother has Some College	0.03	0.07	0.04
Mother has College Degree	0.05	0.08	0.04
Gender (Female=1)	-0.007	-0.006	0.002
Age=1	0.03	0.10	0.06
Age=2	0.18	0.21	0.03
Age=3	0.30	0.36	0.06
Age=4	0.44	0.52	0.08
Age=5	0.60	0.67	0.07
Quintil II	-0.005	0.005	0.01
Quintil III	0.01	0.02	0.01
Quintil IV	0.04	0.03	-0.01
Quintil V	0.07	0.09	0.03
Rural	-0.11	-0.12	-0.01

Note: All estimates are statistically significant at 1%.

Table 2. Number of Children by Date of Birth (mm/yyyy)

Month\Year	2004	2005	2006	2007	2008	2009	*Total*
January	0	14	13	10	15	13	*65*
February	0	4	9	12	11	12	*48*
March	0	11	13	7	7	7	*45*
April	0	11	12	25	20	5	*73*
May	0	13	12	13	14	0	*52*
June	0	12	10	9	9	0	*40*
July	0	8	9	18	19	0	*54*
August	0	10	8	16	11	0	*45*
September	2	14	9	12	13	0	*50*
October	7	11	9	18	9	0	*54*
November	9	19	10	18	12	0	*68*
December	8	10	8	20	10	0	*56*
Total	*26*	*137*	*122*	*178*	*150*	*37*	*650*

Table 3. Family Background Variables

	Observations	Mean	Std. Dev.	Minimum	Maximum
Gender of Child	584	1.48	0.5	1	2
Child's Age	584	30.92	15.66	6	60
Total People in the Household	572	4.95	1.79	2	13
Mother's Education	560	10.94	2.6	1	18
Father's Education	584	7.28	5.57	0	17
Father Missing	584	0.71	0.45	0	1
Age of Mother	566	29.08	7.66	16	60
Age of Father	398	33.11	8.39	16	63
Minimum Distance to Child care Center (meters)	584	356.7	210.17	4.6	1,311.58
Average # of Children per Center	515	34.39	14.25	0	80

Table 4. Number of Children by Each Administered Test

		Children's Cognitive and Socio-Emotional Test Ranges							
Regression Periods		**First**		**Second**		**Third**		**Fourth**	
Months		**13**	**17**	**18**	**23**	**24**	**35**	**36**	**60**
Area	**Test**								
Cognitive	EEDP	**66**		**71**					
	TEPSI					**111**		**123**	
	PPVT							**119**	
Socio-Emotional	ASQ: SE	**69**							
	CBCL			**28**		**67**		**123**	
	IBQ								
	EBQ			**55**		**44**			
	CBQ							**121**	

Table 5. Summary Statistics of Children's Tests by Category

Category	Tests	Subtests	Observations	Mean	Std. Dev.	Minimum	Maximum
Cognitive Tests	TEPSI	Coordination	234	7.68	4.53	0	16
		Language	234	11.85	7.92	0	24
		Motor	234	6	3.29	0	12
		Total	234	25.53	14.75	0	51
	PPVT	Total	119	98.04	15.32	65	138
Socio-Emotional Tests	CBCL	Total	218	55.23	8.55	28	76
	CBQ	Surgency	121	4.64	0.69	2.5	6.42
		Negative Affect	121	4.54	0.67	2.67	6
		Control	121	5.48	0.7	3.08	6.92
		Total	121	14.66	1.12	11.75	16.91
Physical Tests	Weight	Child's Weight	584	14.43	4	1.7	28
		Child's Weight (at Birth)	571	3.36	0.61	0.8	6
	Height	Child's Height	584	0.9	0.13	0.41	1.2
		Child's Height (at Birth)	567	0.5	0.03	0.32	0.57

Table 6. Summary Statistics of Mother's Tests

Category	Test	Subtest	Observations	Mean	Std. Dev.	Minimum	Maximum
Cognitive	WAIS	Numerical	584	8.71	2.05	0	16
		Verbal	584	32.01	16.03	0	72
Socio-Emotional	Big Five Inventory	Extroversion	584	3.47	0.79	1.13	5
		Agreeableness	584	3.8	0.6	1.78	5
		Conscientiousness	584	3.93	0.63	1	5
		Neuroticism	584	3.16	0.87	1	5
		Openness	584	3.76	0.66	1.4	5
Physical		Mother's Weight (Kg)	584	69.39	14.08	39.02	127
		Mother's BMI	584	27.75	6.47	15.24	100
		Height (cm)	584	158.44	6.45	100	177

Table 7. History of Enrollment in Child Care Centers by Type

	0-3 Months	3-6 Months	6-12 Months	12-18 Months	18-24 Months	2-3 Years	3-4 Years	4-5 Years
Particular	1	6	9	10	8	21	24	22
Municipal	0	0	0	4	2	16	25	24
JUNJI	1	2	7	27	31	58	63	22
INTEGRA	0	2	7	9	9	13	17	7
Relative's Workplace	0	1	2	2	2	1	1	0
Other	1	0	0	3	1	1	1	4
No Attendance	581	573	551	459	383	248	112	34
Total	584	584	576	514	436	358	243	113

Table 8. History of Enrollment in Child Care Centers (Public or Private)

	0-3 Months	3-6 Months	6-12 Months	12-18 Months	18-24 Months	2-3 Years	3-4 Years	4-5 Years
Private	1	7	11	12	10	22	25	22
Public	2	4	14	43	43	88	106	57
No Attendance	581	573	551	459	383	248	112	34
Total	584	584	576	514	436	358	243	113

Table 9. Correlation of Mother's Cognitive Tests and Children's Cognitive Test (Age < 2 Years)

	Digit IQ (Mother)	Verbal IQ (Mother)
EEDP Test	0.1157	-0.0263

* Significant at the 95% level

Table 10. Correlation of Mother's Socio-Emotional Tests and Children's Socio-Emotional Tests (Age < 2 Years)

		Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Total
ASQ:SE	6 Months	-0.28	0.249	-0.116	-0.112	-0.109	-0.069
	12 Months	0.017	0.177	0.087	0.138	-0.121	-0.018
	18 Months	0.078	0.082	-0.103	-0.226	0.176	0.162
IBQ	Activity Level	-0.099	-0.061	-0.037	0.178	-0.036	-0.145
	Distress to Limitations	-0.092	-0.288	-0.099	0.210	-0.169	-0.265
	Latency	-0.140	-0.139	-0.005	-0.003	-0.260	-0.155
	Duration of Orienting	0.012	0.121	0.079	-0.117	0.207	0.158
	Smiling and Laughter	-0.118	0.192	0.180	-0.221	0.113	0.173
	Soothability	-0.076	-0.024	0.183	0.150	-0.126	-0.082
EBQ	Negative Affect	-0.097	-0.040	-0.074	0.071	0.018	-0.097
	Surgency	0.113	-0.159	0.024	0.050	0.237*	0.061
	Control	-0.003	0.002	0.088	0.087	0.244*	0.064

* Significant at the 95% level

Table 11. Correlation of Mother's Cognitive Tests and Children's Socio-Emotional Tests (Age < 2 Years)

		Digit IQ	Verbal IQ
ASQ:SE	6 Months	-0.3234	-0.2843
	12 Months	0.0501	0.0312
	18 Months	-0.0589	-0.0098
IBQ	Activity Level	-0.0916	-0.0507
	Distress to Limitations	-0.3196*	-0.138
	Latency	-0.2054	0.0134
	Duration of Orienting	-0.1252	-0.0592
	Smiling and Laughter	0.0348	-0.0126
	Soothability	0.062	-0.0486
EBQ	Negative Affect	0.2716*	-0.0014
	Surgency	-0.0217	-0.0485
	Control	0.0971	0.1189

* Significant at the 95% level

Table 12. Correlation of Mother's Socio-Emotional Tests an Children's Cognitive Tests (Age < 2 Years)

	Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Total
EEDP Test	0.0347*	0.0262	-0.013	0.0342	-0.0288	-0.0064

* Significant at the 95% level

Table 13. Correlation of Children's Cognitive Tests and Children's Socio-Emotional Tests (Age < 2 Years)

		EEDP Test
ASQ:SE	6 Months	-0.2732
	12 Months	0.0572
	18 Months	-0.1051
IBQ	Activity Level	-0.075
	Distress to Limitations	0.208
	Latency	-0.3698*
	Duration of Orienting	0.1569
	Smiling and Laughter	0.0164
	Soothability	-0.0564
EBQ	Negative Affect	0.2564
	Surgency	-0.1892
	Control	0.2127

* Significant at the 95% level

Table 14. Correlation of Mother's Cognitive Tests and Children's Cognitive Tests (Age > 2 Years)

		Digit IQ	Verbal IQ
TEPSI	Total	0.1173	0.1451*
	Coordination	0.0712	0.1460*
	Language	0.1566*	0.1547*
	Motor	0.0504	0.0764
PPVT	Total	0.0687	0.2439*

* Significant at the 95% level

Table 15. Correlation of Mother's Socio-Emotional and Children's Socio-Emotional Tests (Age > 2 Years)

		Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness	BF Total
CBQ	Surgency	0.0379	0.0429	-0.1019	0.1794*	-0.0107	-0.0824
	Negative Affect	0.1154	-0.0674	-0.1121	0.3648*	0.0561	-0.1453
	Control	0.0984	0.1241	0.0202	-0.2049*	0.1829*	0.2233*
	Total	0.1545	0.0635	-0.1177	0.2023*	0.1417	0.0014
CBCL	Total	-0.1683*	-0.1217	-0.2178*	0.3995*	-0.0783	-0.3371*

* Significant at the 95% level

Table 16. Correlation of Mother's Cognitive and Children's Socio-Emotional Tests (Age > 2 Years)

		Digit IQ	Verbal IQ
CBQ	Surgency	-0.0093	0.1002
	Negative Affect	-0.0502	-0.0809
	Control	-0.0623	0.0058
	Total	-0.075	0.0165
CBCL	Total	-0.0824	-0.2334*

* Significant at the 95% level

Table 17. Correlation of Mother's Socio-Emotional and Children's Cognitive Tests (Age > 2 Years)

		Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness	BFI Total
TEPSI	TEPSI Total	0.1578*	0.0854	-0.0394	-0.0517	0.1294*	0.1296*
	Coordination	0.1139	0.0692	-0.0836	-0.0267	0.1015	0.0772
	Language	0.1725*	0.0965	-0.0144	-0.0735	0.1637*	0.1650*
	Motor	0.1349*	0.0549	-0.0264	-0.0181	0.0455	0.0771
PPVT	Total	0.2218*	0.0332	0.1563	-0.1229	0.2418*	0.2661*

* Significant at the 95% level

Table 18. Correlation of Children's Cognitive Tests and Children's Socio-Emotional Tests (Age > 2 Years)

		TEPSI Total	Coordination	Language	Motor	CBCL	PPVT	Surgency	Negative Affect	Control	CBQ Total
TEPSI	Total	1									
	Coordination	0.9316*	1								
	Language	0.9699*	0.8530*	1							
	Motor	0.8613*	0.7423*	0.7625*	1						
CBCL	Total	-0.2055*	-0.1660*	-0.2103*	-0.1833*	1					
PPVT	Total	-	-	-	-	-	1				
CBQ	Surgency	-	-	-	-	-	-0.0247	1			
	Negative Affect	-	-	-	-	-	0.0286	0.1192	1		
	Control	-	-	-	-	-	0.0052	-0.2699*	-0.0206	1	
	Total	-	-	-	-	-	0.0055	0.5191*	0.6636*	0.4474*	1

* Significant at the 95% level

Table 19. Correlation of Mother's Cognitive Tests and Mother's Socio-Emotional Tests

	Digit IQ	Verbal IQ	Extroversion	Agreeableness	Conscientiousness	Neuroticism	Openness
Digit IQ	1						
Verbal IQ	0.2984*	1					
Extroversion	0.0464	0.1105*	1				
Agreeableness	0.1224*	0.055	0.1349*	1			
Conscientiousness	0.0121	0.0847*	0.1103*	0.1990*	1		
Neuroticism	-0.1162*	-0.1663*	-0.1736*	-0.3250*	-0.2279*	1	
Openness	0.1088*	0.2424*	0.3127*	0.1671*	0.2199*	-0.1063*	1

* Significant at the 95% level

Table 20. Probit Model of Children's Attendance at Public and Private Child Care Centers (Older than 2 Years)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Gender (Female=1)	-0.042	-0.059	-0.067	-0.062	-0.078
	(-0.152 , 0.068)	(-0.173 , 0.054)	(-0.182 , 0.048)	(-0.177 , 0.053)	(-0.195 , 0.038)
Age	0.017***	0.017***	0.017***	0.017***	0.017***
	(0.012 , 0.022)	(0.012 , 0.023)	(0.012 , 0.023)	(0.011 , 0.022)	(0.011 , 0.022)
Total People in the Household	-0.055***	-0.051***	-0.052***	-0.051***	-0.05***
	(-0.085 , -0.025)	(-0.082 , -0.021)	(-0.084 , -0.021)	(-0.083 , -0.02)	(-0.082 , -0.019)
Mother's Education		0.019	0.012	0.012	0.009
		(-0.005 , 0.043)	(-0.015 , 0.038)	(-0.015 , 0.038)	(-0.018 , 0.036)
Father"s Education		0.011	0.012	0.012	0.013
		(-0.01 , 0.031)	(-0.01 , 0.033)	(-0.009 , 0.034)	(-0.008 , 0.035)
Father Absent		-0.13	-0.103	-0.106	-0.118
		(-0.365 , 0.106)	(-0.351 , 0.144)	(-0.354 , 0.141)	(-0.365 , 0.129)
Numerical IQ (Mother)			0.026*	0.026*	0.03*
			(-0.005 , 0.056)	(-0.004 , 0.057)	(-0.001 , 0.061)
Verbal IQ (Mother)			-0.001	-0.001	-0.001
			(-0.005 , 0.003)	(-0.005 , 0.003)	(-0.005 , 0.003)
Extroversion (Mother)			0.089**	0.092**	0.095**
			(0.013 , 0.166)	(0.015 , 0.169)	(0.017 , 0.173)
Conscientiousness (Mother)			-0.067	-0.069	-0.056
			(-0.156 , 0.021)	(-0.158 , 0.02)	(-0.147 , 0.034)
Distance to Child care Center				-0.0002*	-0.0002*
				(-0.001 , 0.00004)	(-0.001 , 0.00005)
Avg. # of Children Per Center					-0.0047**
					(-0.009 , -0.00032)
Observations	349	340	340	340	338

Robust 95% confidence intervals in parentheses. *P< .10, **P< .05, ***P< .01

Table 21. OLS and IV Models of Children's Performance in TEPSI Cognitive Test on Their Attendance at Private and Public Child Care Centers

Variable	Coordination (OLS)	Language (OLS)	Motor (OLS)	Total Score (OLS)	Total Score (IV)
Attendance to Child care Center	0.8562**	1.41*	0.563	2.829**	8.085
Gender (Female=1)	1.242***	1.155*	0.358	2.755**	2.968**
Age	0.333***	0.553***	0.181***	1.067***	0.979***
Total People in the Household	-0.015	-0.356**	-0.137	-0.508	-0.259
Mother's Education	-0.019	-0.002	0.022	0	-0.058
Father's Education	0.103	0.19*	0.052	0.345*	0.306
Father Absent	-0.905	-2.165	-0.952	-4.021	-3.704
Numerical IQ (Mother)	0.012	0.368**	-0.027	0.353	0.237
Verbal IQ (Mother)	0.0143	0.022	-0.007	0.03	0.042
Extroversion (Mother)	0.515**	1.133**	0.47*	2.118***	1.492
Conscientiousness (Mother)	-0.3601	0.164	-0.075	-0.27	-0.02
Constant	-8.2551***	-18.458***	-1.962	-28.675***	-27.178***
Observations	208	208	208	208	208

*P< .10, **P< .05, ***P< .01

Table 22. OLS and IV Models of PPVT Tests on Attendance at Private and Public Child Care Centers

Variable	PPVT (Cognitive Test)**	
	OLS	IV
Attendance to Child care Center	2.385	4.261
Gender	-1.13	-1.308
Age	0.22	0.156
Total People in the Household	0.168	0.406
Mother's Education	1.014	0.783
Father's Education	0.029	0.066
Father Absent	0.253	0.233
Numerical IQ (Mother)	-0.061	0.103
Verbal IQ (Mother)	0.189*	0.187*
Extroversion (Mother)	2.942	2.76
Conscientiousness (Mother)	3.953*	4.364
Constant	44.303***	44.87**
Observations	113	112

*P< .10, **P< .05, ***P< .01

**Test standardized by age

Table 23. OLS and IV Models of CBCL Tests on Attendance at Private and Public Child Care Centers

Variable	CBCL (Socio-Emotional Test)**	
	OLS	IV
Attendance to Child care Center	-0.014	-8.305
Gender	-1.088	-1.446
Age	-0.016	0.125
Total People in the Household	0.165	-0.247
Mother's Education	-0.503*	-0.354
Father's Education	0.061	0.061
Father Absent	-1.811	-1.529
Numerical IQ (Mother)	-0.02	0.122
Verbal IQ (Mother)	-0.083**	-0.112**
Extroversion (Mother)	-0.729	0.141
Conscientiousness (Mother)	-2.628***	-2.676***
Constant	79.365***	76.018***
Observations	179	178

*P< .10, **P< .05, ***P< .01

**Test standardized by age

Table 24. OLS and IV Models of Children's Performance in CBQ Socio-Emotional Test on Their Attendance at Private and Public Child Care Centers

Variable	Surgency (OLS)	Negative Affect (OLS)	Control (OLS)	Total (OLS)	Total (IV)
Attendance to Child care Center	-0.275*	-0.076	0.062	-0.288	-0.382
Gender	-0.065	0.232*	0.251*	0.419*	0.418*
Age	0.009	0.006	-0.008	0.006	0.008
Total People in the Household	-0.004*	0.112***	0.004	0.112**	0.106
Mother's Education	0.033	0.013	0.009	0.054	0.058
Father's Education	-0.016	-0.028	-0.003	-0.047	-0.047
Father Absent	0.091	0.248	0.222	0.561	0.555
Numerical IQ (Mother)	-0.033	-0.017	-0.033	-0.082	-0.083
Verbal IQ (Mother)	0.003	-0.006	0.0002	-0.003	-0.0029
Extroversion (Mother)	-0.04	0.101	0.105	0.165	0.167
Conscientiousness (Mother)	-0.1706*	-0.1405	0.0169	-0.2942*	-0.3103
Constant	5.253***	3.8068***	5.0459***	14.1057***	14.1342***
Observations	115	115	115	115	114

*P< .10, **P< .05, ***P< .01

Table 25. OLS and IV Models of Child's Height and Weight on Their Attendance at Private and Public Child Care Centers

Variable	Height (m)		Weight (Kg)		BMI (Kg/cm^2)	
	OLS	IV	OLS	IV	OLS	IV
Attendance to Child care Center	0.008	-0.0628	0.2221	-1.2028	-0.22	0.1717
Gender	-0.0088	-0.0133	-0.1858	-0.2856	0.0228	0.0437
Age	0.0067***	0.0078***	0.2049***	0.2262***	-0.0295**	-0.0359
Total People in the Household	0.0017	-0.0013	-0.0187	-0.0755	-0.1088	-0.0897
Mother's Education	0.0001	0.0006	0.0307	0.0376	-0.006	-0.0108
Father's Education	0.00129	0.00201	0.01946	0.03483	-0.00985	-0.01284
Father Absent	-0.0126	-0.0194	-0.6343	-0.7717	-0.0862	-0.0489
Numerical IQ (Mother)	-0.00186	-0.00031	-0.09387	-0.05948	-0.05708	-0.06262
Verbal IQ (Mother)	0.000342	0.000258	0.011615	0.009801	0.00051	0.000913
Extroversion (Mother)	0.00276	0.0076	0.03874	0.12968	-0.08619	-0.11717
Conscientiousness (Mother)	0.0036	0.0003	0.3666*	0.3027	0.1556	0.1732
Constant	0.6855***	0.6822***	7.2624***	7.2183***	19.3266***	19.3618***
Observations	340	338	340	338	339	337

*P< .10, **P< .05, ***P< .01

Table 26. Estimates of the Parameters of Unobserved Cognitive and Socio-emotional Distributions

	Estimate	St.Dev.
σ(cognitive)	0.590	0.100
σ(socio-emotional)	0.788	0.000
ρ(correlation)	0.070	0.053

Table 27A. Structural Model of Mother's Cognitive Tests -WAIS

	Digit	Reverse Digit	Vocabulary
Age of Mother	-0.014**	-0.012**	0.011**
Mother's Education	0.073***	0.070***	0.142***
Constant	-0.395**	-0.418*	-1.882***
Cognitive	0.629***	1	0.609***
Socio-emotional	-	-	-
Precision	0.904***	0.760***	0.835***

Robust 95% confidence intervals in parentheses
*P< .10, **P< .05, ***P< .01

Table 27B. Structural Model of Mother's Socio-Emotional Tests, BF Extroversion Subtest

	Q1	Q6	Q11	Q16	Q21	Q26	Q31	Q36
Age of Mother	0.003	-0.007	0.002	0.002	-0.011*	0.003	0.005	-0.002
Mother's Education	0.022**	0.013	0.008	0.021	0.062***	-0.003	0.027**	-0.043***
Constant	-0.249	0.012	-0.164	-0.276	-0.334	-0.001	-0.375*	0.569**
Cognitive	-	-	-	-	-	-	-	-
Socio-emotional	0.484***	0.325***	0.107***	0.111***	1	0.221***	0.481***	0.381***
Precision	0.866***	0.948***	0.990***	0.990***	0.675***	0.967***	0.862***	0.937***

Robust 95% confidence intervals in parentheses
*P< .10, **P< .05, ***P< .01

Note: The questions are: I see myself as someone who...Q1: is talkative. Q6: is reserved; Q11: is full of energy; Q16: generates a lot of enthusiasm; Q21: tends to be quiet; Q26: has an assertive personality; Q31: is sometimes shy, inhibited; Q36: is outgoing, sociable.

Table 28. Structural Model of Children's Attendance at Public Child Care Centers (Older than 2 Years)

	Results
Gender	-0.173
Total People in the Household	-0.141***
Mother's Education	0.031
Father's Education	0.018
Father Missing	-0.194
Age Cohort 1 (30-36 Months)	-0.075
Age Cohort 2 (36-42 Months)	0.897***
Age Cohort 3 (42-48 Months)	0.880***
Age Cohort 4 (48-54 Months)	0.978***
Age Cohort 5 (54-60 Months)	1.307***
Distance to Child care Center	-0.597*
Avg. # of Children Per Center	-0.01**
Cognitive	0.162
Socio-emotional	0.184**

Robust 95% confidence intervals in parentheses
*P< .10, **P< .05, ***P< .01

Table 29. Structural Model of Children's Performance on TEPSI Cognitive Test on their Attendance at Public and Private Child Care Centers

	Child care	Homecare
Gender	0.157	0.304**
Total People in the Household	-0.007	-0.021
Mother's Education	-0.037	0.058*
Father's Education	0.080***	-0.003
Father Missing	-0.736**	-0.442*
Age Cohort 1 (30-36 Months)	-0.160	-0.287*
Age Cohort 2 (36-42 Months)	-0.048	0.191
Age Cohort 3 (42-48 Months)	-0.259	-0.516**
Age Cohort 4 (48-54 Months)	0.278	0.684**
Age Cohort 5 (54-60 Months)	-0.347	-0.228
Constant	0.369	-0.744
Cognitive	0.372**	-0.203
Socio-emotional	0.321***	0.109*
Precision	0.887***	0.762***

*P< .10, **P< .05, ***P< .01

Table 30. Structural Model of Children's Performance on CBCL Non-Cognitive Test on their Attendance at Public and Private Child Care Centers

	Child care	Homecare
Gender	-0.278*	0.030
Total People in the Household	0.002	0.020
Mother's Education	-0.089***	-0.038
Father's Education	-0.022	-0.002
Father Missing	-0.151	-0.080
Age Cohort 1 (30-36 Months)	-0.866**	0.538**
Age Cohort 2 (36-42 Months)	-0.186	0.021
Age Cohort 3 (42-48 Months)	-0.464	0.174
Age Cohort 4 (48-54 Months)	-0.254	-0.128
Age Cohort 5 (54-60 Months)	-0.473	0.623
Constant	2.102***	0.199
Cognitive	-0.109	-0.458*
Socio-emotional	-0.087	-0.077
Precision	0.882***	0.864***

*P< .10, **P< .05, ***P< .01

Table 31. Structural Model of Children's Performance on CBQ Non-Cognitive Test on their Attendance at Public and Private Child Care Centers

	Surgency (Child care)	Surgency (Homecare)	Neg. Affect (Child care)	Neg. Affect (Homecare)	Control (Child care)	Control (Homecare)
Gender	0.047	-0.333	0.49**	-0.158	0.556**	-0.054
Total People in the Household	-0.025	-0.035	0.19***	0.138**	0.042	-0.054
Mother's Education	-0.084*	0.172**	-0.003	-0.113**	-0.062	0.049
Father's Education	0.006	-0.016	-0.072	0.053*	0.06	-0.011
Father Missing	0.043	-0.624	0.44	-0.133	-0.557	0.563
Age Cohort 3 (42-48 Months)	0.019	0.600*	-0.218	0.183	-0.157	-0.489
Age Cohort 4 (48-54 Months)	-0.114	0.300	-0.045	0.592**	-0.23	-0.264
Age Cohort 5 (54-60 Months)	-0.040	0.372	-0.118	0.159	-0.263	-0.178
Constant	0.861	-0.600	-1.335*	0.304	-0.255	-0.172
Cognitive	0.140	-1.254**	-0.396*	-0.853**	0.123	-0.563
Socio-emotional	0.068	0.226*	0.217**	0.208*	0.055	0.102
Precision	0.885***	0.622***	0.905***	0.602***	1.005***	0.805***

*P< .10, **P< .05, ***P< .01

Table 32. Structural Model of Children's Physical Test on their Attendance at Public and Private Child Care Centers

	Weight (Kg, Child care)	Weight (Kg, Homecare)	Height (cm, Child care)	Height (cm, Homecare)
Gender	-0.025	-0.294	-1.551*	-0.09
Total People in the Household	-0.042	-0.049	0.117	0.288
Mother's Education	0.048	0.093	0.228	0.181
Father's Education	0.104*	-0.027	0.104	0.077
Father Missing	-1.479*	0.235	0.288	-1.323
Age Cohort 1 (30-36 Months)	1.185*	0.779	5.558**	4.263***
Age Cohort 2 (36-42 Months)	1.743**	3.098***	9.102***	10.959***
Age Cohort 3 (42-48 Months)	3.744***	3.727***	12.841***	13.538***
Age Cohort 4 (48-54 Months)	5.815***	3.343***	15.394***	18.176***
Age Cohort 5 (54-60 Months)	6.396***	6.502***	19.249***	22.45***
Constant	13.54***	13.458***	86.791***	84.159***
Cognitive	-0.328	0.248	-0.284	-0.45
Socio-emotional	0.09	-0.039	-0.328	0.356*
Precision	2.42***	2.525***	6.152***	5.212***

*P< .10, **P< .05, ***P< .01

Table 33. Treatment Effect Estimates of Attendance at Child Care Centers from Structural Model

	ATE	TT	TUT	AMTE
TEPSI	0.302	0.324	0.281	0.414
	(0.034,0.586)	(0.063,0.604)	(-0.028, 0.617)	(0.011, 0.733)
CBCL	0.191	0.142	0.240	0.342
	(-0.147,0.610)	(-0.241,0.550)	(-0.164,0726)	(-0.095,0.748)
CBQ-surgency	-0.254	-0.326	-0.180	-0.130
	(-0.764,0.269)	(-0.866,0.154)	(-0.897,0.463)	(-0.852,0.457)
CBQ- Negative Affect	0.101	0.018	0.187	0.027
	(-0.388,0.498)	(-0.463,0.448)	(-0.356,0.642)	(-0.478,0.544)
CBQ- Control	-0.141	-0.144	-0.138	0.004
	(-0.670,0.304)	(-0.677,0.376)	(-0.685,0.384)	(-0.721,0.443)
Weight (klg)	-0.023	-0.001	-0..045	0.144
	(-0.577,0.478)	(-0.635,0.590)	(-0.654,0.481)	(-0.610,0.717)
Height (cm)	0.665	0.265	1.074	0.753
	(-0.834,2.057)	(-1.056,1.707)	(-0.800,2.662)	(-0.810,2.792)

Note: For cognitive and socio-emotional test scores we report the standardized treatment effects (% of std. deviations). The numbers in this table are obtained using the estimates from our structural model and simulations based on our original data. The number in brackets represent the confidence interval (5%, 95%) obtained using bootstrapping. The treatment parameters are defined as:

$$\Delta^{ATE} = \iint E\left(Y^1 - Y^0 \mid X = x, \theta = t\right) dF_{X,\theta}\left(x,t\right),$$

$$\Delta^{TT} = \iint E\left(Y^1 - Y^0 \mid X = x, \theta = t, D = 1\right) dF_{X,\theta|D=1}\left(x,t\right).$$

$$\Delta^{TUT} = \iint E[Y^1 - Y^0 \mid X = x, \theta = t, D = 0) dF_{x,\theta|D=0}(x,t)$$

$$\Delta^{AMTE} = \iint E[Y^1 - Y^0 \mid X = x, \theta = t, S^* = 0) dF_{x,\theta|S^*=0}(x,t)$$

where we integrate with respect to the distribution of unobserved cognitive and socio-emotional abilities.

Appendix

Table A1. Results from Focus Group with Psychologists

Children			
Area	**Test**	**Positive Evaluation**	**Negative Evaluation**
Cognitive	EEDP		
	TEPSI		
	BWS		
	PPVT		
	HTKS		
Socio-Emocional	ASQ: SE		
	CBCL		
	IBQ		
	EBQ		
	CBQ		
Physical	Weights		
	Height		
	C. Circun.		
Mothers			
Area	**Test**	**Positive Evaluation**	**Negative Evaluation**
Cognitive	WAIS		
Socio-Emocional	SWLS		
	BFI		
Physical	Weights		
	Height		
Home Evaluation	HOME		

Table A2. Probit Model of Children's Attendance at Public Child Care Centers (Older than 2 Years)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Gender	-0.05	-0.067	-0.079	-0.069	-0.086
	(-0.168 , 0.068)	(-0.189 , 0.054)	(-0.204 , 0.045)	(-0.194 , 0.057)	(-0.214 , 0.041)
Age	0.015***	0.015***	0.015***	0.014***	0.014***
	(0.009 , 0.021)	(0.009 , 0.021)	(0.009 , 0.021)	(0.008 , 0.02)	(0.008 , 0.02)
Total People in the Household	-0.053***	-0.05***	-0.051***	-0.05***	-0.049***
	(-0.084 , -0.021)	(-0.082 , -0.017)	(-0.084 , -0.018)	(-0.082 , -0.016)	(-0.083 , -0.016)
Mother's Education		0.012	-0.0003	0.0008	-0.0008
		(-0.015 , 0.038)	(-0.03 , 0.029)	(-0.029 , 0.03)	(-0.03 , 0.029)
Father's Education		0.013	0.013	0.014	0.015
		(-0.009 , 0.035)	(-0.01 , 0.037)	(-0.009 , 0.037)	(-0.009 , 0.038)
Father Absent		-0.132	-0.088	-0.085	-0.095
			(-0.359 , 0.183)	(-0.356 , 0.186)	(-0.367 , 0.177)
Numerical IQ (Mother)			0.035**	0.035**	0.039**
			(0.001 , 0.068)	(0.002 , 0.069)	(0.005 , 0.074)
Verbal IQ (Mother)			-0.0004	-0.0004	-0.0007
			(-0.005 , 0.004)	(-0.005 , 0.004)	(-0.005 , 0.004)
Extroversion (Mother)			0.102**	0.102**	0.106**
			(0.018 , 0.185)	(0.019 , 0.186)	(0.022 , 0.19)
Conscientiousness (Mother)			-0.087*	-0.089*	-0.074
			(-0.182 , 0.008)	(-0.184 , 0.006)	(-0.171 , 0.023)
Distance to Child care Center				-0.0003**	-0.0003**
				(-0.001 , -0.00002)	(-0.001 , -0.00001)
Avg. # of Children Per Center					-0.0043*
					(-0.009 , 0.00046)
Observations	302	294	294	294	293

Table A3. Probit Model of Children's Attendanceat Private Child Care Centers (Older than 2 Years)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Gender	-0.047	-0.055	-0.055	-0.055	-0.059
	(-0.166 , 0.071)	(-0.175 , 0.064)	(-0.175 , 0.065)	(-0.175 , 0.065)	(-0.18 , 0.062)
Age	0.008***	0.01***	0.011***	0.01***	0.01***
	(0.003 , 0.014)	(0.005 , 0.015)	(0.005 , 0.016)	(0.005 , 0.016)	(0.005 , 0.016)
Total People in the Household	-0.038**	-0.032*	-0.032*	-0.031*	-0.03*
	(-0.073 , -0.003)	(-0.067 , 0.003)	(-0.067 , 0.003)	(-0.066 , 0.004)	(-0.066 , 0.005)
Mother's Education		0.041***	0.037**	0.037**	0.037**
		(0.015 , 0.067)	(0.009 , 0.066)	(0.008 , 0.066)	(0.008 , 0.066)
Father's Education		0.006	0.007	0.008	0.007
		(-0.015 , 0.027)	(-0.015 , 0.029)	(-0.014 , 0.03)	(-0.015 , 0.029)
Father Absent		-0.04	-0.035	-0.043	-0.038
		(-0.321 , 0.24)	(-0.322 , 0.252)	(-0.334 , 0.248)	(-0.328 , 0.252)
Numerical IQ (Mother)			0.02	0.021	0.022
			(-0.012 , 0.052)	(-0.011 , 0.052)	(-0.01 , 0.054)
Verbal IQ (Mother)			-0.002	-0.002	-0.002
			(-0.006 , 0.002)	(-0.006 , 0.002)	(-0.006 , 0.002)
Extroversion (Mother)			0.043	0.046	0.043
			(-0.038 , 0.125)	(-0.036 , 0.127)	(-0.039 , 0.125)
Conscientiousness (Mother)			-0.005	-0.007	-0.007
			(-0.102 , 0.092)	(-0.104 , 0.091)	(-0.104 , 0.09)
Distance to Child care Center				-0.0001	-0.0001
				(-0.0004 , 0.0002)	(-0.0004 , 0.0002)
Avg. # of Children Per Center					-0.0021
					(-0.0066 , 0.0023)
Observations	199	193	193	193	193

Table A4. OLS and IV Models of Children's Performance in TEPSI Cognitive Test on Their Attendance at Public Child Care Centers

Variable	Coordination	Language	Motor	Total	IV Regression
Attendance at child care center	0.726*	1.44*	0.52	2.687**	1.93
Gender	1.036***	1.024	0.321	2.381*	2.236
Age	0.337***	0.575***	0.183***	1.096***	1.109***
Total People in the Household	-0.009	-0.336*	-0.152	-0.497	-0.532
Mother's Education	-0.053	-0.069	0.048	-0.073	-0.09
Father's Education	0.11*	0.156	0.01	0.276	0.269
Father Absent	-0.886	-1.755	-0.759	-3.4	-3.407
Numerical IQ (Mother)	-0.045	0.268	-0.068	0.154	0.167
Verbal IQ (Mother)	0.023*	0.031	-0.002	0.052	0.048
Extroversion (Mother)	0.504*	1.132**	0.386	2.021**	2.063
Conscientiousness (Mother)	-0.423	0.095	-0.186	-0.514	-0.394
Constant	-7.379***	-17.646***	-1.124	-26.148***	-26.3***
Observations	177	177	177	177	176

*P< .10, **P< .05, ***P< .01

Table A5. OLS and IV Models of Children's Performance in TEPSI Cognitive Test on Their Attendance at Private Child Care Centers

Variable	Coordination	Language	Motor	Total	IV Regression
Attendance at child care center	1.198**	0.171	0.78	2.149	11.041
Gender	1.747***	1.871**	0.966*	4.584***	5.228***
Age	0.332***	0.589***	0.187***	1.108***	0.944***
Total People in the Household	0.003	-0.383**	-0.061	-0.441	-0.258
Mother's Education	0.001	0.143	-0.03	0.114	-0.215
Father's Education	0.071	0.014	0.028	0.112	0.166
Father Absent	-1.298	-0.974	-1.515	-3.787	-4.278
Numerical IQ (Mother)	0.019	0.376*	-0.001	0.394	0.068
Verbal IQ (Mother)	0.02	0.025	-0.002	0.043	0.068
Extroversion (Mother)	0.493	1.099**	0.373	1.965**	1.41
Conscientiousness (Mother)	-0.084	1.263*	0.34	1.519	0.76
Constant	-10.039***	-26.152***	-4.004	-40.195***	-27.78
Observations	127	127	127	127	127

*P< .10, **P< .05, ***P< .01

Table A6. OLS and IV Models of Children's Performance in CBQ Socio-Emotional Test on Their Attendance at Public Child Care Centers

Variable	Surgency	Negative Affect	Control	Total	IV Regression
Attendance at child care center	-0.304**	-0.116	0.04	-0.38	-0.015
Gender	-0.054*	0.186	0.197	0.328	0.346
Age	0.017	0.006	-0.01	0.013	0.008
Total People in the Household	-0.008	0.114***	0.015	0.122**	0.137*
Mother's Education	0.054	0.002	-0.003	0.053	0.047
Father's Education	-0.017	-0.028	-0.016	-0.06	-0.063
Father Absent	0.079	0.236	0.254	0.57	0.575
Numerical IQ (Mother)	-0.018	-0.025	-0.051	-0.094	-0.102
Verbal IQ (Mother)	0.0033	-0.0058	0.0023	-0.0002	-0.0005
Extroversion (Mother)	-0.093	0.058	0.077	0.042	0.049
Conscientiousness (Mother)	-0.1978*	-0.1791**	-0.0235	-0.4004**	-0.3395
Constant	4.8668***	4.3475***	5.6808***	14.8952***	14.6816***
Observations	100	100	100	100	100

*P< .10, **P< .05, ***P< .01

Table A7. OLS and IV Models of Children's Performance in CBQ Socio-Emotional Test on Their Attendance at Private Child Care Centers

Variable	Surgency	Negative Affect	Control	Total	IV Regression
Attendance at child care center	-0.627**	0.0003	0.0467	-0.5801	-1.2179
Gender	-0.103	0.082	-0.006	-0.026	0.042
Age	0.006	-0.002	-0.014	-0.01	-0.004
Total People in the Household	0.016	0.088*	-0.096	0.008	-0.029
Mother's Education	0.186***	0.002	0.035	0.223***	0.262*
Father's Education	-0.058	0.001	0.015	-0.042	-0.037
Father Absent	-0.05	0.276	0.416	0.642	0.554
Numerical IQ (Mother)	-0.09*	-0.002	-0.058	-0.15*	-0.166*
Verbal IQ (Mother)	-0.0093	-0.0142***	0.0017	-0.0218**	-0.0233**
Extroversion (Mother)	-0.172	0.137	0.262*	0.227	0.2
Conscientiousness (Mother)	-0.4076**	-0.1045	0.0389	-0.4731*	-0.5221*
Constant	6.3803***	4.2855***	5.2684***	15.9343***	15.9695***
Observations	100	100	100	100	100

*P< .10, **P< .05, ***P< .01