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Chapter 2

Trade-offs between different early childhood interventions: Evidence from Ecuador[1]

2.1 Introduction

More than 200 million children under 5 years in developing countries are exposed to the risks of poverty, malnutrition, poor health and unstimulating home environments (Grantham-McGregor et al., 2007). This is supposed to be detrimental for the development of these children, which in turn contributes to low levels of education, low income and high fertility. Governments of developing countries and NGO's are aware of this vicious circle of poverty and allocate resources to preschool interventions with the aim to provide disadvantaged children in developing countries a better start (Engle et al., 2007).

Compared to the many studies dealing with early childhood programs in developed countries, little is known about the effects of such programs in the context of developing countries.[2] A few studies used randomized control trials to examine the impact of home-based or center-based interventions in developing countries. McKay et al. (1978) study a child care program aimed at deprived children in Colombia and find positive effects on cognitive ability. Waber et al. (1981) examine the effects of nutritional supplementation and/or a maternal education program, also in Colombia, on young children's cognitive development. Food supplementation boosts performance, especially on motor sub-

[1]This chapter is based on Rosero and Oosterbeek (2011). Trade-offs between different early childhood interventions: Evidence from Ecuador. Discussion Paper 11-031/1. Tinbergen Institute.

[2]Studies for developed countries include: Currie and Thomas (1995); Gormley, Jr. and Gayer (2006); Magnuson et al. (2007); Baker et al. (2008); Wong et al. (2008); Datta Gupta and Simonsen (2010); Felfe and Lalive (2010); Fitzpatrick (2010); Havnes and Mogstad (2011). Currie (2001) and more recently Almond and Currie (2011) survey this literature, see also Barnett (2011).

tests. Powell et al. (2004) find positive effects of a home visit program in Jamaica on children's cognitive outcomes.

Other studies rely on non-experimental approaches to address the potential endogeneity of treatment. Attanasio and Vera-Hernandez (2004) use distance to the nearest center as an instrumental variable to evaluate the effect of a nutrition and child care program in rural Colombia on children's nutritional status, school achievement and female labor supply. They find very large and positive impacts, especially for children from the poorest backgrounds.[3] Behrman et al. (2004) apply a matching estimator to assess the impacts of a preschool program in Bolivia on child outcomes. Impacts are highly dependent on age and exposure duration. Significant positive effects on cognitive and psychosocial outcomes are found when exposure is at least 7 months. Berlinski and Galiani (2007) exploit variation across regions in facilities expansion, to examine the impact of construction of pre-primary school facilities in Argentina. They find a sizable impact on pre-primary school participation among children aged between 3 and 5. The implicit child care subsidy induced by the program also increases maternal employment.[4]

This chapter examines the impact of both child care centers and of home visits on a range of relevant outcomes of young children and their mothers from poor families in Ecuador. The largest organization that funds early childhood programs in Ecuador ranks proposals of prospective providers of such programs on the basis of a score which is a mixture of perceived quality of the providers and indicators of the social background of the families served by the program. The organization then allocates its available budget to the programs with the highest scores. This creates a discontinuity of almost 100 percentage points in the probability of treatment at the score where the available budget of the funding organization is exhausted.

We exploit this feature in a regression discontinuity design in which we instrument a child's exposure to treatment with a binary indicator that equals one if the child was listed for a program that received a score at or above the cutoff score, and zero if the child was listed for a program that received a score below the cutoff score. In the analysis we control for the programs' underlying scores. This approach provides a credible source of exogenous variation to identify the effects of the two treatments relative to their respective control groups. Because prospective providers choose themselves whether to apply for funding for a child care center or for home visits, we combine the regression discontinuity design with a difference-in-differences approach (and matching)

[3]Attanasio et al. (2010) extend the analysis to data from urban areas and use additional instrumental variables. Their results confirm the previous findings.

[4]In a related paper Berlinski et al. (2008) find that one year of pre-primary school increases average third grade test scores by 23% of the standard deviation. They also find effects on student's self-control, effort, class participation, and discipline.

to compare the impacts of the two treatments.

Four features of this chapter stand out. First, we evaluate and compare the impacts of two different early childhood interventions using the same sampling design, the same tests and questionnaires and the same estimation method. We are not aware of other studies doing so. Second, we consider a range of outcomes: children's cognitive and motor development, children's health, parenting styles, mothers' labor supply and income, and mothers' stress and depression.[5] Looking at this broad range of outcomes gives a more complete picture of the effects of early childhood interventions. Also here, we are not aware of many other studies doing so. Third, in comparison to most other studies for developing countries, we collected data from a relatively large sample of over 2500 children and their mothers. Finally, we analyze a large scale national program instead of a small, tailor-made intervention.

Our results show that home visits have a positive impact on children's cognitive and motor outcomes, whereas child care centers appear to have no impact on these outcomes. Home visits reduce the likelihood that children have anemia and have no impact on their weight for age and height for age. Child care centers, in contrast, increase the probability that children are underweight. Furthermore, home visits reduce mothers' depression and stress and make them more responsive towards their children. Child care centers do the opposite: they increase mothers' depression and stress and reduce responsiveness. Finally, child care centers increase mothers' labor market participation and income, while home visits reduce mothers' labor market participation but leave family income unaffected. The two types of interventions thus represent a trade-off between child outcomes and mother's psychological well-being on the one hand, and labor market participation and family income on the other hand.

Our findings are consistent with a framework in which children's outcomes are determined by the quantity and the quality of time spent with them by the mother and by the early childhood program, and in which the psychological well-being of the mother is determined by her working hours and the outcomes of the child. In this framework, child outcomes and mother's psychological well-being are adversely affected by child care centers through the negative effect these centers have on the mother's parenting style and through the increase of mother's working hours. Home visits do not have adverse effects since this intervention improves mother's parenting styles and reduce her working hours.

Our findings regarding child care centers are in line with results recently reported by Baker et al. (2008) for Canada. Exploiting the introduction of universally accessible child care in the province of Quebec in a difference-in-differences framework, they find

[5]Engle et al. (2007) draw attention to the fact that women in developing countries have high rates of stress and that many suffer from depressive symptoms.

that child care use increases maternal labor supply but harms child outcomes in terms of aggression, motor and social skills and illness. Moreover, parenting becomes more hostile and less consistent, and parents' health worsens.

The chapter proceeds as follows. The next section provides further details about the early childhood development programs in Ecuador and about the context. Section 2.3 discusses the empirical approach used to identify the programs' impacts and to compare these. Section 2.4 describes the sampling design and the scales on which various outcomes are measured. Section 2.5 provides descriptive statistics of the main variables used in the analysis and evidence that the groups above and below the funding threshold are not systematically different. Section 2.6 presents and discusses the empirical results. Section 2.7 presents a simple framework that helps to understand the coherence of our findings. Section 2.8 summarizes and concludes.

2.2 Context and interventions

2.2.1 Context

Ecuador is a lower-middle income country, characterized by high poverty levels and high inequality. Of its total population of 13 million people, 1.5 million are children between 0 to 5 years old. 650,000 of these young children live in families belonging to the poorest 40 percent of the country. The 40th percentile of the wealth distribution is the government's threshold level for cash transfers to poor families. According to Grantham-McGregor et al. (2007) Ecuador was in 2004 among the four countries in South-America where 20 to 40 percent of children under 5 years are disadvantaged; the others are Peru, Bolivia and Paraguay. In the rest of South-America the percentage of disadvantaged children below age 5 is less than 20 percent. Paxson and Schady (2007) document a strong association in Ecuador between socio-economic status and children's early cognitive development. Schady (2011) shows that this association persists into primary school age and that early scores are strong predictors of later scores.

Early childhood development programs in Ecuador are offered by both private and public providers. Private provision is small and mainly targeted towards middle and high income families. Public provision primarily serves low income families. The public provision is targeted towards children in rural and marginal urban areas. There are three main public providers, the largest of these is the Child Development Fund, "Fondo de Desarrollo Infantil" in Spanish and abbreviated as FODI.[6] FODI started in 2005 and currently serves around 300,000 children from poor families all around Ecuador.

[6]The other two large public providers are INNFA (for "Instituto del Nino y la Familia") and ORI (for "Operacion Rescate Infantil").

2.2.2 Programs

FODI supports two types of programs: child care centers and home visits. One third of the children served by FODI attends a child care center, the other two thirds are exposed to home visits. The main objective of the programs is to improve the early development of young children from poor families. A program is provided at the community or neighborhood level. There is never more than one program per community/neighborhood.

Child care centers provide day care, nutrition (breakfast and lunch) and educational services. Day care is provided following a curriculum designed by FODI, 52 weeks per year, 5 days per week, and 8 hours per day. A trained teacher works with groups of 8 to 10 children. An average center serves 45 children in the age range of 0 to 6 years.[7] The annual cost amounts to US$ 488 per child. To put this amount into perspective, the average monthly income in our sample is US$ 300 per family or US$ 55 per capita.[8] Parents do not pay a fee; FODI bears the full cost.

Through home visits, FODI attempts to stimulate children and to improve parents' attitudes, knowledge and behavior towards the development of their children. An important aim of the home visits is to teach mothers how to engage with their child in enriching activities, how to interact with their child in a non aggressive way, how to create a responsive environment and how to prepare nutritional meals for their children. Children and their mother are treated individually when the child is younger than 3 and in groups when the child is above 3. Home visits last 1 hour per week. Advisers work according to guidelines set by FODI. The annual cost of this intervention is US$ 109 per child. Also here, FODI bears the full cost, and parents are not charged.

Children who are not served by one of the programs – the control groups – are normally looked after by their mother or another family member (grandparents or older sibling) or a neighbor.

2.2.3 Selection process

FODI does not run its own centers but subsidizes non-profit suppliers of early childhood development centers. FODI allocates its budget through a (beauty) contest. So far it organized such contests in 2005, in 2006 and in 2008. In this chapter we use data from applicants (winners and losers) to the contest of 2006. This contest was targeted to poor unserved neighborhoods or communities. The available budget for this contest was US$ 12 million. 240 organizations submitted a proposal, 95 of which were awarded

[7] Primary education in Ecuador starts when children are 6 years old. Enrollment in primary school is almost universal, but drops sharply at the secondary school level (see Oosterbeek et al., 2008a).

[8] In 2000, Ecuador adopted the US dollar as its official currency.

for a total coverage of 60,000 children. Awarded proposals initially receive funding for a two year period, which is normally renewed afterward.

In the 2006-contest, a proposal was only considered for funding if (i) it included a list with the names of the children it would serve if awarded, (ii) the area was not yet served by a public provider, and (iii) the proposal fulfilled certain standards regarding infrastructure and educators' skills. Proposals meeting these requirements were given a score based on five criteria (behind each criterion, the maximum number of points that can be earned for it): socioeconomic characteristics of the neighborhood (180); coherence of the proposal (130); share of outside funding (30); quality of personnel (150); financial aspects (110).

Adding the maximum scores per element gives an overall maximum score of 600. FODI then allocated its available budget for the second contest by funding proposals from high to low until the budget was exhausted. In practice FODI spent the last dollar of the available budget on a proposal that received an overall score of 425.[9] [10] We will exploit this funding threshold in a regression discontinuity design. The threshold could not be anticipated by the applicants or the organizers, reducing the likelihood of manipulation. The discontinuity applies at the level of proposals and not at the level of children listed in a proposal. There is no ranking of individual children within or across proposals.

2.3 Empirical approach

We are interested in the impact of exposure to child care centers and home visits on outcomes of children and their mothers. Naive OLS-regressions are likely to give biased estimates due to (self-)selection into treatment. For instance, programs may specifically target their efforts towards children that would otherwise be severely deprived. Without intervention these children would probably have worse outcomes than other children. Or likewise, parents may for some reason prefer to enroll their smarter children into preschool programs. Without exposure to a treatment these children would probably have better outcomes than other children.

The way in which FODI allocated its budget in the second contest provides a regression discontinuity design which we will exploit to estimate the causal impacts of the two interventions (cf. Imbens and Lemieux, 2008; Lee and Lemieux, 2010). The

[9]Beforehand, a score of 400 was set as the minimum required quality standard. Proposals with a score below 400 would not qualify for funding even if the available budget was not exhausted.

[10]The proposal with the lowest score that received funding was a proposal for a home visiting program, but the same cutoff score then applies to proposals for child care centers. All proposals for child care centers with a score above 425 received funding, while no proposal for child care centers with a score below 425 received funding.

regression discontinuity design boils down to an instrumental variable approach in which the binary indicator (Z) of having a score above or below the funding threshold is used as instrument for exposure to treatment. In this approach we can condition on a smooth function of the underlying score (s) (referred to as the forcing variable) and other covariates (X). This gives the following equation for home visits:

$$Y_i = \alpha_{HV} + \delta_{HV} HV_i + f_{HV}(s_i) + X_i \beta_{HV} + \varepsilon_{HVi} \tag{2.1}$$

where Y is the outcome variable, and HV is a binary indicator which is equal to one if the child was exposed to home visits and equal to zero if the child was assigned to the comparison group for home visits. Likewise to evaluate the impact of child care centers we estimate:

$$Y_i = \alpha_{CC} + \delta_{CC} CC_i + f_{CC}(s_i) + X_i \beta_{CC} + \epsilon_{CCi} \tag{2.2}$$

where $CC = 1$ if the child was enrolled in a child care center and $CC = 0$ for children assigned to the comparison group for child care centers.

The specification of the smooth function of the forcing variable can in some applications of the regression discontinuity design be a delicate choice. This is not the case in our application. In the main text we will present graphs based on linear regressions on both sides of the cutoff point (as recommended by Imbens and Lemieux, 2008) and estimates based on quadratic specifications of $f_{HV}(s)$ and $f_{CC}(s)$. In Tables A2-A4 in the appendix we present results based on other specifications (including a spline and a cubic). These tables show that results are very similar for different specifications of $f_{HV}(s)$ and $f_{CC}(s)$.

The identifying assumption in this framework is that conditional on covariates and the forcing variable, treatment is as good as random. In the equations, HV_i and CC_i are instrumented by Z_i, where $Z_i = 1$ if $s_i \geq s_0$, and $Z_i = 0$ if $s_i < s_0$, and where s_0 is the funding threshold of the overall score which for both programs equals 425. The parameters of interest are δ_{HV} and δ_{CC}. To avoid confusion, note that these parameters are estimated on different samples. The impact of home visits is estimated using a sample of children and their mothers who were on the list of a proposal for a home visit program, while the impact of child care centers is estimated using a sample of children and their mothers who were on the list of a proposal for a child care center program.[11]

The regression discontinuity design allows us to estimate the impact of an intervention for children and their mothers that were listed for that intervention. It does not allow us to estimate the impact of one intervention versus the other intervention. The

[11] We are thus also not using one single instrumental variable Z to estimate two parameters.

reason is that (prospective) providers of early childhood development programs decide on the type of program they want to offer. If we assume that the difference in outcomes between the two comparison groups measures the no-intervention difference for the two treatment groups, we can use a difference-in-differences approach to estimate the impact of one intervention versus the other. The estimator for the impact of home visits relative to child care centers is then:

$$(E[Y|HV = 1] - E[Y|CC = 1]) - (E[Y|HV = 0] - E[Y|CC = 0])$$

where $E[Y|x = 1]$ is the average outcome for children exposed to treatment x, and $E[Y|x = 0]$ is the average outcome for children assigned to the comparison group of treatment x. We implement this by estimating the following regression with instrumental variables:

$$Y_i = \beta_0 + \beta_1 LHV_i + \beta_2 T_i + \beta_3 LHV_i \cdot T_i + f(s_i) + f(s_i \cdot LHV_i) + X_i\beta_4 + LHV_i \cdot X_i\beta_5 + \epsilon_i \quad (2.3)$$

where $LHV_i = 1$ indicates that a child's name appeared on the list of a proposal submitted for funding as home visit program (whether they were treated or not), $LHV_i = 0$ if the child's name appeared on the list of a proposal submitted for funding as child care center program. $T_i = 1$ indicates exposure to one of the two programs, $T_i = 0$ otherwise. T_i and $LHV_i \cdot T_i$ are instrumented with Z_i and $LHV_i \cdot Z_i$. Note that the effect of the forcing variable and of the control variables X_i are allowed to vary between the two interventions. Ignoring covariates (X_i), β_1 is now the average difference in outcomes between children listed for child care centers and children listed for home visits in the absence of treatment, whereas β_2 is the average difference in outcomes between children in the control group and in the treatment group for child care centers. β_3 is the average difference in outcomes between children enrolled in child care centers and children exposed to home visits.

The estimate of β_3 can only be interpreted as the causal effect of exposure to home visits instead of placement in child care centers if the treatment effect is homogeneous. This excludes selection into programs on the basis of comparative advantage. This would for instance be the case if children exposed to home visits benefit more from home visits than children placed in child care centers. To examine the robustness of our findings, we estimate this difference-in-differences equation not only on the full sample, but also on a sample of observations with a very similar propensity to be on the list for home visits (instead of for a child care center). We implement this by first regressing the binary indicator for being on the list for home visits (LHV) on observables (X), then calculating for each observation its predicted probability to be on the list for home visits, and based on this restrict the sample to observations with

a predicted probability that is within 1.06 standard deviation of the mean predicted probability. The value of 1.06 was chosen such that in this restricted sample the groups actually on the list for home visits and actually on the list for child care centers are not significantly different on any of the background variables that we include in the analysis. The leaves us with 68 percent of the original sample.

2.4 Data

The data that is used in this study comes from a self-collected survey designed to evaluate the impact of early development programs in Ecuador (ENEVIN).[12] The sample design of the component of the ENEVIN that is employed to estimate the impact of FODI follows the empirical approach described in section 2.3 which is based on a contest of proposals submitted by non-profit suppliers. In the 2006 contest, a total of 113 submitted proposals passed the minimum quality requirement of 400 points. Because data collection is expensive and available resources for this project limited, we focused data collection on proposals with a score relatively close to the funding threshold. For the appreciation of the results reported in this chapter, it is important to consider that we thus start with a sample that can be regarded as a discontinuity sample (e.g. Angrist and Lavy, 1999). We subsequently selected a random sample of the centers that were included in these proposals. Recall that one proposal can include multiple centers. Within each center, we selected a random sample from the children whose names were on the list attached to the proposal.[13] Notice that the lists with names of the children that would be served are vital for our design. Without those lists it is impossible to know which children would have been treated by the providers that did not receive funding.

The final sample consists of 2,707 children in 99 centers; 38 providing child care centers and 61 home visits. Table 2.1 shows the numbers of observations (children and centers) in our final sample by type of program, age group and treatment eligibility.[14] We present a breakdown by age because some cognitive and motor tests are only validated for children older than 36 months while others are only validated for children younger than 60 months.

Teams of data collectors visited the homes of all children included in the final sample. They collected data through interviews with the mothers and through tests

[12]The other two programs that were evaluated using this survey are ORI and INNFA. The results related to the impact of ORI are presented in chapter 3 of this dissertation.

[13]The random sampling of centers and children was done to stay within the budget constraint of this research project.

[14]As we will show in Section 2.5 treatment eligibility and actual exposure to treatment are very highly correlated.

Table 2.1. Number of children by program, eligibility and age (number of centers in parentheses)

Program	Age	Non-eligible	Eligible	Total
Home visits	all	830 (28)	988 (33)	1818 (61)
	age >36 months	739 (27)	794 (33)	1533 (60)
	age <60 months	465 (27)	704 (33)	1169 (60)
Child care centers	all	411 (12)	478 (26)	889 (38)
	age >36 months	371 (11)	421 (26)	792 (37)
	age <60 months	194 (12)	318 (26)	512 (38)

and measurements. Data were collected between September and December of 2008. At the moment of data collection, treated children in our sample had an average exposure to treatment of 21 months. This is the same for child care centers and home visits.

We used standard and validated test instruments to measure the cognitive, motor and social-emotional development of children. Some tests are specific for children older than 36 months. These are the Spanish versions of the Peabody Picture Vocabulary test which measures receptive vocabulary (language), the Woodcock-Johnson-Munoz test which measures long term memory, and the Pegboard test which measures fine motor skills. For all children from 0 to 60 months old, we use the Nelson-Ortiz test which is the official instrument used by Ecuadorian authorities to monitor the development of the children served by public providers. The test measures four dimensions of child development: language skill, gross motor skill, fine motor skill and social behavior and allows to construct a total test of child development by summing the scores obtained in each dimension.

Test scores are standardized by age. We normalized the scores on the Peabody, Woodcock and Pegboard tests to mean zero and standard deviation one. Impact estimates are thus expressed in standard deviation units. Scores on the Nelson Ortiz tests are binary: above or below the mean of the age group.[15]

To measure children's health we use height for age and weight for age. Height for age is an indicator for long-term health outcomes, while weight for age more reflects short-term health conditions. We also took blood samples to measure the hemoglobin levels of the children to detect iron deficiency anemia. For the mothers we measure the following outcomes: the Center for Epidemiological Studies Depression (CES-D) scale to measure depression and psychological stress, the Home Observation for Measurement of the Environment (HOME) scale to measure responsiveness to children, and variables related to the labor market such as participation, working hours and income. The CES-

[15]The definition of the Nelson Ortiz score as binary variable is in accordance to the criterion adopted by Ecuadorian authorities to evaluate the development of children in the early educational programs provided by the State.

D covers the main symptoms of depression and is derived from five validated depression scales. The score on the HOME test is based on the interviewer's evaluation of the mother's attitudes and behavior towards the child during the interview. We converted respondents' scores on the CES-D test and the HOME test to mean zero and standard deviation one, so that again impact estimates are measured in standard deviation units.

2.5 First stage and identifying assumptions

In this section we will first show that whether a proposal is above or below the funding threshold almost perfectly determines whether a child that is on the list of a proposal, is exposed to treatment. We then discuss the identifying assumption and provide evidence in support of it.

All proposals with a score above the threshold received funding from FODI and all proposed programs had been implemented at the moment of data collection. Likewise, none of the proposals with a score below the threshold received funding from FODI and none of these proposed programs have been implemented. At the proposal or program level, the allocation of FODI's budget thus represents a sharp regression discontinuity design; the score assigned to the proposal perfectly determines whether the proposal receives funding and whether the proposed program is implemented.

The sharp design at the proposal or program level translates into an almost sharp design at the level of children. Just a few children included in a proposal that received funding did not participate in the program, and also just a few children included in a proposal that did not receive funding participated in an(other) early childhood program.[16] The almost perfect compliance with the assigned treatment status results in first stage estimates close to one. Table 2.2 shows this, for both interventions and for various specifications.[17]

As mentioned before, proposals with a score above 425 (on a scale from 0 to 600) received funding and proposals with a lower score did not. Table 2.3 shows average values of the scores for proposed programs above and below the threshold in our sample, separately for home visits and for child care centers. The table also shows the average scores the proposed centers received on each of the five components of the total score. The main factors determining whether proposals for home visit centers ended up below the threshold are the quality of staff and financial aspects of the proposals (see column (3)). There is no significant difference with respect to the social economic background of

[16] Two children did not participate in a home visit program while they should, 9 children did not participate in a child care center program while they should, 7 children participated in a home visit program while they should not, and 5 children participated in a child care center while they should not.

[17] Results are virtually identical when we control for higher order terms of rank.

Table 2.2. First stage regressions

	(1)	(2)	(3)
Home visits			
Above threshold (Z)	0.990***	0.983***	0.980***
	(0.003)	(0.009)	(0.008)
F-test instrument	93652	12171	13765
Number of children (programs)	1818 (60)	1818 (60)	1818 (60)
Child care centers			
Above threshold (Z)	0.968***	0.980***	0.969***
	(0.020)	(0.024)	(0.029)
F-test instrument	2427	1661	1165
Number of children (programs)	889 (38)	889 (38)	889 (38)
Controls			
rank	No	Yes	Yes
X	No	No	Yes

Note: Estimates from linear probability models of actual treatment on assigned treatment. Robust standard errors that are clustered at the program-level in parentheses. *** indicates significance at the 1%-level. Background controls are the variables included in Table 2.4.

the communities that are proposed to be served. Also for child care centers, the quality of the proposed staff is the main factor determining whether a proposal ends up above or below the threshold (see column (6)). Three other factors also show significant differences between proposals above and below the threshold, but the differences in points on these items are small. The final column of the table compares the scores of home visits versus child care center proposals. This shows that home visits are proposed for communities/neighborhoods with a higher social-economic status (and therefore collect fewer points for SES) than the communities/neighborhoods for which child care centers are proposed. This underscores the importance to balance the children listed for the two programs when we compare the two treatments. There are otherwise no significant differences in the scores that the proposals for child care centers and for home visits received. We are thus comparing two types of interventions that, at least according to this grading system, are of comparable quality.

The identifying assumption in the regression discontinuity design is that conditional on a smooth function of the underlying score and observables included in the analysis, there are no systematic unobserved differences between observations just below the threshold and observations just above the threshold. While this assumption cannot be tested, we can test whether observations above and below the threshold are not systematically different in terms of their observable characteristics.

Table 2.4 shows the average values for important background variables separately for observations below and above the funding threshold and separately for the two

Table 2.3. Components of score

Variable	Home visits (HV)			Child care centers (CC)			HV vs CC
	$s < 425$	$s \geqslant 425$	p	$s < 425$	$s \geqslant 425$	p	p
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total score	416.33	452.82	0.000	408.05	447.05	0.000	0.020
	(5.96)	(13.82)		(7.25)	(12.51)		
SES	173.04	172.58	0.781	177.92	174.23	0.004	0.003
	(6.43)	(6.39)		(2.58)	(4.84)		
Co-funding	25.91	25.70	0.910	20.67	23.46	0.002	0.749
	(7.21)	(6.89)		(0.99)	(4.06)		
Quality of staff	22.60	48.73	0.000	15.97	44.36	0.000	0.108
	(12.55)	(10.29)		(14.51)	(18.57)		
Coherence	107.45	110.72	0.194	108.10	114.19	0.078	0.251
	(10.59)	(8.03)		(10.68)	(7.29)		
Financial aspects	87.34	95.10	0.003	85.41	90.81	0.118	0.763
	(8.87)	(11.83)		(7.25)	(9.79)		
N	28	33		12	26		99

programs. It also reports the p-values from a t-test for differences in means conditional on a second order polynomial of the forcing variable. The p-values in columns (3) and (6) of Table 2.4 indicate that the characteristics of children eligible for treatment are in most cases not significantly different from the characteristics of children not eligible for treatment. There is only a systematic difference in age.[18] In the samples of both programs eligible children are significantly younger than non-eligible children; the age gap is about 6 months. Part of this difference can be attributed to eligible children being interviewed earlier than non-eligible children. But even after we correct for that, a significant difference remains. We have no explanation for this. It makes it important, however, to control in all analyses for age.[19] Recall also that all outcome variables are standardized by age.

The last two columns of the table report the p-values for differences in characteristics between children whose name appeared on the list of a proposal for home visits and children whose name appeared on the list of a proposal for a child care center. This information is useful for our difference-in-differences approach. The results show that children listed for child care centers are significantly older than children listed for home visits. There also is a difference in social background between children listed for home visits and children listed for child care centers. This difference shows up in the schooling levels of the mother and of the household head, mother's language-score, household size

[18]The differences between eligible and non-eligible children are also statistically significant for gender in the home visits program and for receipt of the cash transfer in the child care center program. The means of the these variables are, however, almost identical for eligible and non-eligible children.

[19]We also redid all analyses including higher order terms of age. This does not change any of the results.

Table 2.4. Differences by eligibility status

Variable	Home visits (HV)			Child care centers (CC)			HV vs CC	
	$s < 425$	$s \geqslant 425$	p	$s < 425$	$s \geqslant 425$	p	All	Balanced
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Boy (dummy)	0.52	0.51	0.050	0.50	0.52	0.274	0.743	0.626
	(0.50)	(0.50)		(0.50)	(0.50)			
Age in months	55.8	49.6	0.000	58.3	52.0	0.002	0.055	0.631
	(14.4)	(12.9)		(14.3)	(12.4)			
Household size	4.87	4.85	0.437	5.70	5.25	0.245	0.026	0.721
	(1.71)	(1.71)		(1.97)	(2.00)			
Urban (dummy)	0.70	0.66	0.934	0.49	0.40	0.802	0.088	0.612
	(0.46)	(0.48)		(0.50)	(0.49)			
Cash transfer (dummy)	0.58	0.55	0.388	0.61	0.58	0.036	0.460	0.501
	(0.50)	(0.50)		(0.49)	(0.49)			
Mother's age (years)	30.7	30.5	0.847	31.6	30.6	0.109	0.283	0.884
	(8.56)	(8.12)		(8.46)	(7.96)			
Schooling mother (yrs)	7.24	7.61	0.421	5.38	5.96	0.375	0.000	0.108
	(3.66)	(4.13)		(3.55)	(3.56)			
Schooling head (yrs)	6.66	6.72	0.968	5.51	5.74	0.854	0.006	0.405
	(3.87)	(5.36)		(3.50)	(3.37)			
Language score mother	72.1	70.5	0.994	59.78	62.2	0.398	0.016	0.642
	(23.9)	(26.2)		(26.0)	(25.1)			
Father present	0.72	0.81	0.436	0.83	0.77	0.154	0.324	0.903
	(0.45)	(0.39)		(0.38)	(0.42)			
Mother present	0.95	0.96	0.721	0.95	0.96	0.940	0.734	0.968
	(0.22)	(0.21)		(0.23)	(0.19)			
N	830	988		411	478		2707	1837

Note: Mean values and standard deviations in parentheses. p-values are based on t-tests for equality of means. In columns (3) and (6) these are conditional on a second degree polynomial in the score.

and the wealth index. As we already saw in Table 2.3, home visits serve children from relatively better-off families.

Because of the differences between the groups targeted by the two interventions, we constructed a balanced sample. On the basis of a linear probability model we estimated for each observation the probability to be listed for home visits instead of a place in a child care center.[20] We then restricted the sample to observations for which the predicted probability to be listed for home visits differs at most 1.06 standard deviation from the mean. The remaining sample covers 68 percent of the observations from the original sample. The final column in the table shows p-values for differences in characteristics between children actually listed for home visits and children actually listed for a child care center in this balanced sample. This shows that these groups are not significantly different in any of the characteristics included in the analysis.[21] [22]

2.6 Results

This section presents in three subsections results for children's cognitive outcomes, for children's health outcomes, and for mothers' outcomes. Each subsection starts with a graphical presentation. We then present and discuss estimates of the impact of the two interventions on the various outcomes. For each set of outcomes there is also a table in the appendix with results from alternative specifications.

2.6.1 Children's cognitive and motor outcomes

Figure 2.1 shows the relation between children's score on the Woodcock-Johnson-Munoz memory test and the rank of the proposed child care centers for which these children were listed. Each hollow circle in the graph represents the mean outcome of the children that were on the list of the same child care center. The size of the circles is proportional to the number of children that were listed for that center in the proposal. The solid lines represent the best linear fits through the hollow circles, where we weighted by number of children. The lines are drawn separately below and above the threshold value of 425. Below the graph we report an estimate of the discontinuity at the threshold, with its standard error. This estimate comes from a regression that allows for separate linear relations in rank at both sides of the threshold and includes no other control variables.

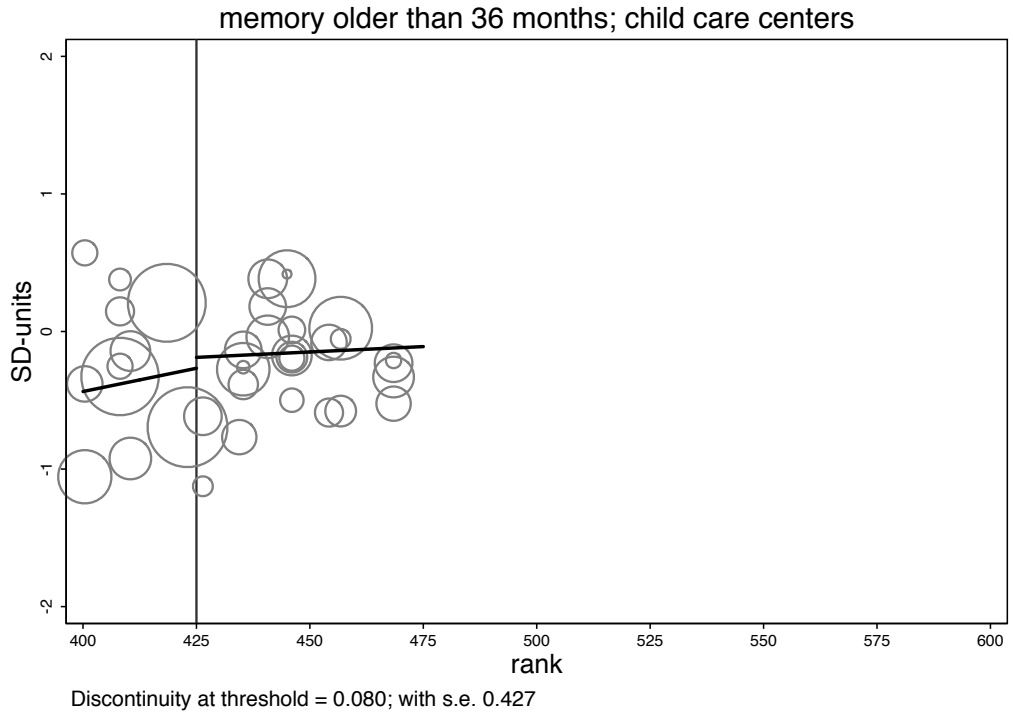
To make explicit that the sample of the proposals with which we work all have scores close to the threshold value of 425, the horizontal axis of the graph covers the

[20] The results are reported in Table A1 in the appendix.

[21] When we broaden the sample to at most 1.07 standard deviation from the mean, mother's education starts to be significantly different between the groups.

[22] This restriction of the sample is similar in spirit to propensity score matching. The advantage of this procedure is that we can still use the regression discontinuity design.

Figure 2.1. Relation between memory score and rank of proposed child care center



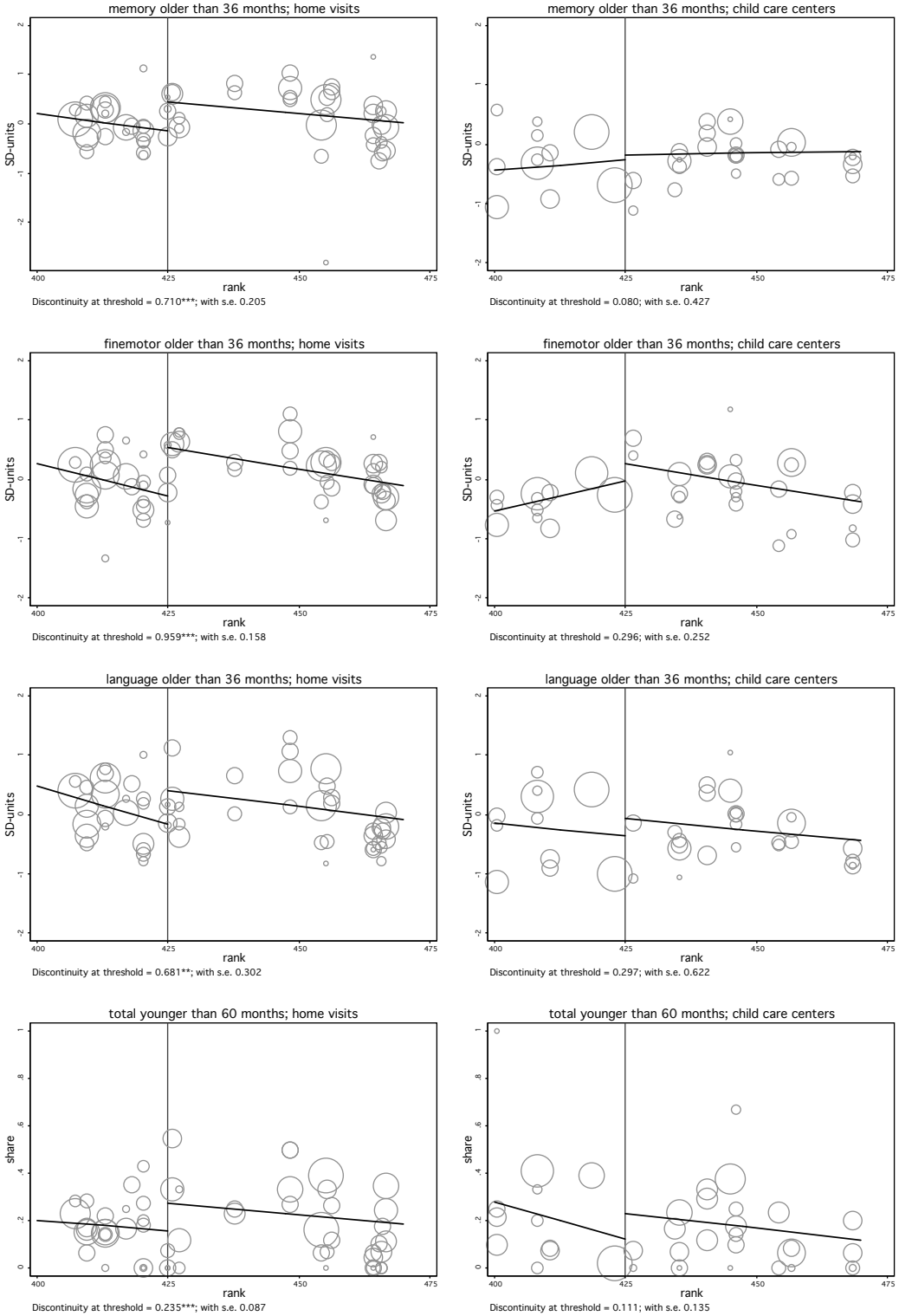
Note: Each hollow circle in the graph represents the mean value of the score on the Woodcock-Johnson-Munoz memory test for children in the same child care center. The size of a circle is proportional to the number of children in the center. The solid lines represent the linear best fits through the circles (weighted by circle size), separately below and above the threshold rank of 425.

entire range from the minimum required score of 400 to the maximum feasible score of 600. In subsequent graphs we will zoom in on the narrower range from 400 to 475 that we used to collect data. Figure 2.2 shows the zoomed-in graphs for four different cognitive outcomes for both types of interventions, where the top-right graph repeats Figure 2.1.

The graphs show that the relationship between rank and outcomes is not very systematic or strong. In most cases the slopes of the solid lines are not significantly different from zero. For most outcomes this relation tends to be negative, also for the proposals that received funding. Recall that the rank of a proposal is also determined by the social economic status of the community it intends to serve, where the rank increases when the community is poorer.

The graphs for the home visits intervention (on the left hand side of the figure) show increases in the cognitive scores around the discontinuity. The solid line right of the discontinuity starts at a higher level than where the solid line left of the discontinuity ends. In all cases the discontinuities at the threshold are significantly different from zero. The picture is less clear in the graphs for child care centers (on the right hand side of the figure). For all four measures the discontinuities at the thresholds indicate

Figure 2.2. Relation between cognitive outcomes and rank by type of intervention



Note: Each hollow circle in a graph represents the mean value of the outcome value in a unit for home visits/child care centers. The size of a circle is proportional to the number of children in the unit. The solid lines represent the linear best fits through the circles (weighted by circle size), separately below and above the threshold rank of 425. "total" in the bottom graphs is the average of gross motor, fine motor, language and social.

an increase in the score, but these increases are never significantly different from zero.

We further investigate this in Table 2.5, which reports various estimates of the impact of the two interventions for all cognitive and motor outcomes that were measured. The first three columns relate to tests administered for children older than 36 months and the last five columns relate to tests administered for children younger than 60 months. The top panel presents the impacts of home visits (versus no intervention) and the middle panel presents the impacts of child care centers (also versus no intervention). These results are IV-estimates based on equations (2.1) and (2.2), respectively. Results are given for two specifications; the first only includes controls for linear and quadratic terms of rank, while the second also controls for background characteristics.[23]

The results for home visits in the top panel reveal the same clear pattern as Figure 2.2. Home visits have a positive impact on most outcomes and in both specifications. Adding covariates produces very similar, but more precise estimates. Focusing on the specification with covariates all estimates for children older than 36 months as well as two of the four tests and the overall test for children under 60 months show significant improvements of cognitive outcomes for children exposed to home visits. The impact sizes are substantial. The first three outcomes are measured in standard deviation units, hence the impacts vary between 40 and 84 percent of a standard deviation. The last five outcomes are measured as the probability to be above the mean score of the age group. The overall score goes up by 20 percentage points, relative to a base of 17 percent.

For child care centers none of the estimates differs significantly from zero. While this might be partly due to the relatively large standard errors, we note that most of the standard errors in the second specification are small enough to turn estimates of the magnitudes we find for home visits, significantly different from zero. Across the different outcomes, the estimates vary in sign. This also indicates that there is no consistent pattern in the impact of child care centers on children's cognitive outcomes.[24]

The bottom panel in Table 2.5 shows difference-in-differences estimates based on equation (2.3) to compare the impacts of home visits relative to the impacts of child care centers. The first set of results is based on the entire sample, while the second set of results is based on the balanced (68%) sample of observations that have a similar predicted probability to be listed for home visits. While results vary somewhat across the two samples, the findings point in the same direction: children's cognitive and motor development benefits more from home visits than from child care centers. The effects

[23]In Table A2 in the Appendix we report results for other specifications, including a spline in rank, a linear specification and a cubic specification. Results are very similar.

[24]We also inquired whether impacts are different for boys than for girls, and for children above and below 24 months old. Neither for home visits nor for child care centers, do we find any evidence for heterogeneity of impacts across these groups.

Table 2.5. Cognitive and motor outcomes

	Older than 36 months			Younger than 60 months				
Specification	Memory	Fine motor	Language	Gross motor	Fine motor	Language	Social	Total
				Home visits				
rank, rank squared	0.549**	0.845***	0.459	0.160	0.065	0.016	0.155	0.194*
	(0.221)	(0.164)	(0.353)	(0.124)	(0.067)	(0.063)	(0.123)	(0.104)
rank, rank squared, X	0.557***	0.841***	0.400***	0.183*	0.070	0.027	0.191**	0.201***
	(0.131)	(0.155)	(0.154)	(0.093)	(0.050)	(0.046)	(0.093)	(0.068)
N	1510	1521	1514	1187	1192	1189	1192	1170
				Child care centers				
rank, rank squared	-0.031	0.136	0.182	0.108	0.083	0.106	0.249	0.088
	(0.526)	(0.271)	(0.780)	(0.066)	(0.101)	(0.068)	(0.177)	(0.180)
rank, rank squared, X	-0.291	0.019	-0.127	0.064	0.068	0.080	0.161	0.049
	(0.309)	(0.232)	(0.302)	(0.064)	(0.048)	(0.058)	(0.155)	(0.111)
N	770	773	767	542	540	540	543	532
				Home visits vs. child care centers				
DD-IV	0.849***	0.813***	0.542	0.117	-0.001	-0.055	0.029	0.145
whole sample	(0.332)	(0.274)	(0.337)	(0.113)	(0.069)	(0.074)	(0.177)	(0.127)
N	2280	2294	2281	1729	1732	1729	1735	1702
DD-IV	1.406***	1.497***	1.017***	0.129	0.021	0.031	0.230	0.278*
restricted sample	(0.337)	(0.371)	(0.355)	(0.137)	(0.083)	(0.103)	(0.228)	(0.148)
N	1549	1558	1553	1153	1157	1154	1158	1136

Note: Each estimate comes from a separate IV-regression where a dummy for being at or above the funding threshold is the instrument. Background controls are the variables included in Table 2.4. Robust standard errors that are clustered at the program-level in parentheses. */**/*** denote significance at a 10/5/1% confidence level. The restricted sample includes observations whose predicted probability to be on a list for home visits (instead of child care centers) is within 1.06 standard deviation of the sample's mean probability to be on such a list. "Total" in the final column is the average of gross motor, fine motor, language and social.

are quite substantial. For instance, being exposed to home visits instead of attending a child care center increases the memory score by around one standard deviation unit.

2.6.2 Children's health outcomes

We next look at the impact of the programs on children's health outcomes. Figure 2.3 shows the relationships between rank and the three health outcomes: anemia, underweight and below height. The two graphs at the top of the figure reveal a clear picture: the share of children with anemia drops sharply around the threshold value of rank for the home visits intervention and it increases slightly for the child care center intervention. The discontinuity at the threshold is significantly different from zero for the home visits, but not for the child care centers. For underweight and below height, the graphs reveal only small discontinuities at the thresholds and these are not significantly different from zero.

Further results are presented in Table 2.6.[25] Home visits reduce the incidence of anemia by 16 percentage points, independent of the specification. Relative to a base of 0.46, this implies a reduction in anemia by about one third. The impact of home visits on weight for age and height for age are small and not significantly different from zero. This contrasts with the impact of child care centers on children's health. Attendance to child care centers has no impact on the incidence of anemia or being below height, but in the specification with control variables, it increases the probability of being underweight by 11 percentage points (relative to a baseline of 0.06), thereby reflecting short-term health problems such as diarrhea. The bottom panel presents estimates from the difference-in-differences specifications to compare the two treatments. While the estimates all point in the direction that home visits have a more favorable impact on children's health than child care centers, these differences lack statistical significance.

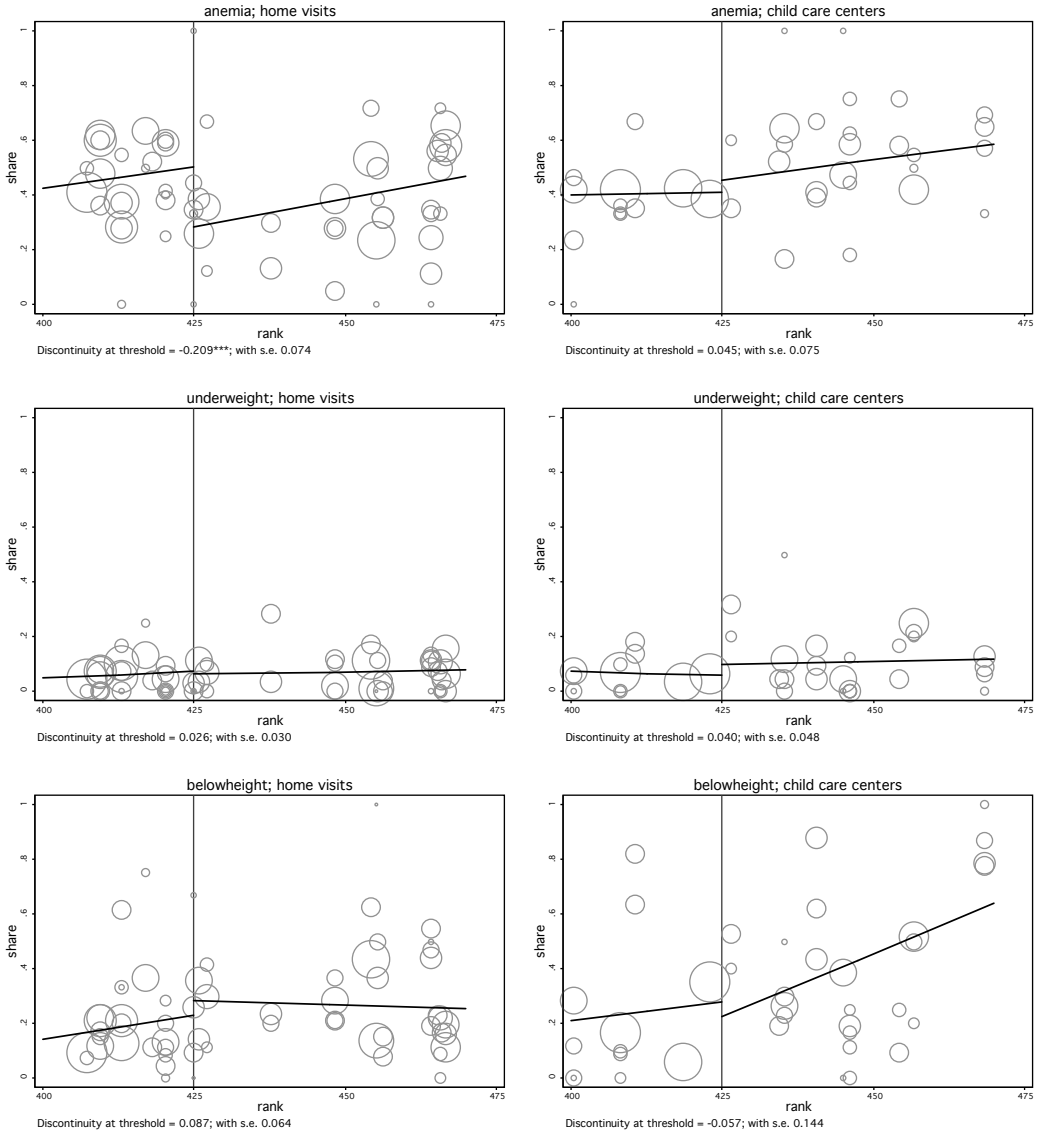
2.6.3 Mothers' outcomes

Early childhood interventions potentially also have an impact on the way mothers interact with their children and on mothers' psychological well-being and labor market outcomes. Figures 2.4 and 2.5 show for each intervention the relations between rank and mothers' outcomes. The two graphs in the top of Figure 2.4 indicate that home visits reduce non-responsive behavior of mothers towards their children, while child care centers evoke such behavior. The discontinuities at the thresholds are significant at the 1%-level in both graphs.

The second pair of graphs in Figure 2.4 shows small increases in the likelihood that mothers read to their children when exposed to the programs, but in neither case is this

[25] Results for other specifications are presented in Table A3 in the appendix.

Figure 2.3. Relation between health outcomes and rank by type of intervention



Note: Each hollow circle in a graph represents the mean value of the outcome value in a unit for home visits/childcare centers. The size of a circle is proportional to the number of children in the unit. The solid lines represent the linear best fits through the circles (weighted by circle size), separately below and above the threshold rank of 425.

Table 2.6. Health outcomes

Specification	Anemia	Under weight	Below height
Home visits			
rank, rank squared	-0.157**	0.030	0.050
	(0.075)	(0.028)	(0.067)
rank, rank squared, X	-0.167**	0.029	0.035
	(0.066)	(0.027)	(0.061)
N	1658	1787	1769
Child care centers			
rank, rank squared	0.055	0.051	0.006
	(0.072)	(0.048)	(0.156)
rank, rank squared, X	0.003	0.109***	0.100
	(0.117)	(0.035)	(0.082)
N	763	872	870
Home visits vs. child care centers			
DD-IV	-0.170	-0.074*	-0.060
(whole sample)	(0.130)	(0.042)	(0.101)
N	2421	2659	2639
DD-IV	-0.213	-0.079	-0.158
(restricted sample)	(0.133)	(0.059)	(0.143)
N	1641	1795	1782

Note: See the note of Table 2.5.

increase statistically significant. Also for presence of learning materials in the home the discontinuities at the thresholds lack significance. The final pair of graphs in the figure indicate that home visits reduce mothers' stress and depression while child care centers lead to an increase of these symptoms. The discontinuity at the threshold is significantly different from zero in the graph for home visits.

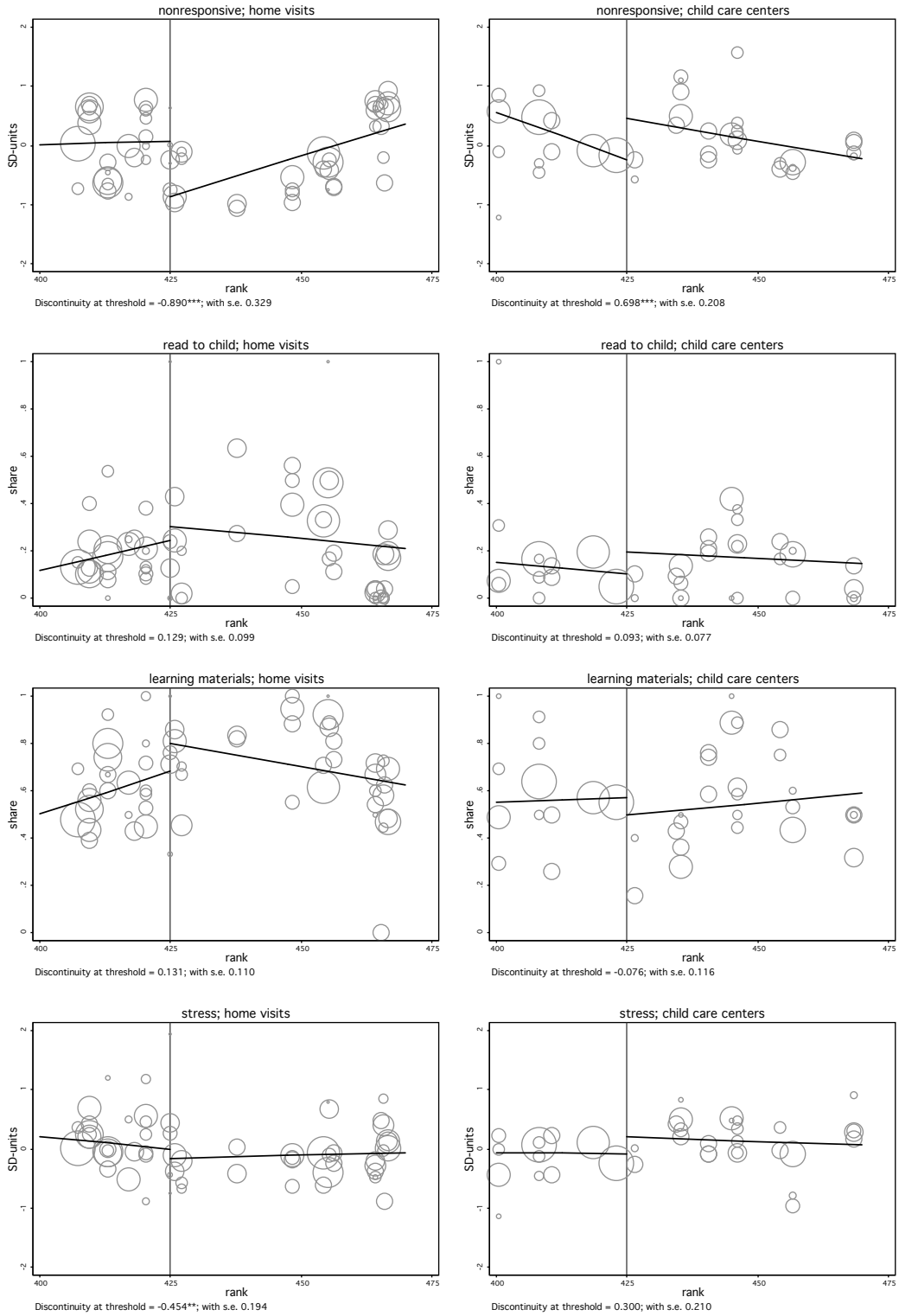
The estimation results presented in columns (1) to (4) of Table 2.7 confirm the results from the graphs.[26] Focusing on the results from the specification with controls for background characteristics, we find that home visits make mothers more responsive to their children, while child care centers reduce responsiveness. The dependent variable here is measured in standard deviation units, so home visits increase responsiveness by half a standard deviation unit, while child care centers decrease it by more than 0.8 standard deviation unit. Being exposed to home visits has no impact on mothers reading to their children or the children having learning materials (books, clay, toys) at home. Attending a child care center has no significant impact on mothers reading to their children but it reduces the probability of having learning materials at home. The fourth column confirms that home visits reduce stress and depression in mothers whereas child care centers have the opposite impact. Effects are again in standard deviation units, implying that home visits reduce stress and depression by 0.3 standard deviation while child care centers increase it by close to 0.4 standard deviation. These impacts are quite substantial.

The results in the bottom panel of the table show that these findings also hold when we compare the two treatments directly: when the child is exposed to home visits instead of a child care center, mothers are more responsive and their psychological well-being improves considerably.

Figure 2.5 shows for both interventions the relations between the forcing variable and labor market outcomes. The two graphs at the top of this figure clearly suggest that home visits reduce the incidence of mothers working, while child care centers increase this. The discontinuities at the thresholds are significantly different from zero. A similar pattern is observed in the second pair of graphs for the number of hours that the mother works. Again the discontinuities at the thresholds are significantly different from zero. The pair of graphs for the income of mothers is consistent with this. Mothers' income goes down in case of home visits while it increases when the child is enrolled in a child care center. Here only the discontinuity at the threshold in the graph for child care centers is statistically significant. The final pair of graphs in the figure demonstrate the relationship with the income generated by the head of the household. For both interventions, we see a tendency for household heads to earn

[26] See also Table A4 in the appendix for results from alternative specifications. Almost all results we report in Table 2.7 are robust to changes in the specification. When this is not the case, we mention that in the main text.

Figure 2.4. Relation between mothers' outcomes and rank by type of intervention



Note: Each hollow circle in a graph represents the mean value of the outcome value in a unit for home visits/childcare centers. The size of a circle is proportional to the number of children in the unit. The solid lines represent the linear best fits through the circles (weighted by circle size), separately below and above the threshold rank of 425.

Table 2.7. Parenting and labor market outcomes

Specification	Non-responsiveness (1)	Read (2)	Learning material (3)	Stress/ depression (4)	Labor mother (5)	Hours mother (6)	Income mother (7)	Income head (8)
				Home visits				
rank, rank squared	-0.564	0.021	0.024	-0.388*	-0.219*	-9.339**	-25.292	5.466
	(0.346)	(0.104)	(0.116)	(0.206)	(0.117)	(3.690)	(20.947)	(37.832)
rank, rank squared, X	-0.516*	-0.002	0.016	-0.299*	-0.186*	-7.887**	-25.766	4.930
	(0.263)	(0.039)	(0.082)	(0.156)	(0.097)	(3.105)	(15.283)	(17.596)
N	1798	1818	1818	1817	1818	1816	1818	1817
				Child care centers				
rank, rank squared	0.770***	0.069	-0.121	0.292	0.380***	13.819***	39.653***	97.621***
	(0.214)	(0.092)	(0.123)	(0.232)	(0.128)	(4.752)	(14.205)	(31.572)
rank, rank squared, X	0.845***	-0.024	-0.203*	0.383**	0.307***	11.389***	27.660***	96.173***
	(0.185)	(0.041)	(0.107)	(0.168)	(0.104)	(3.231)	(9.301)	(14.547)
N	870	889	889	889	889	888	889	887
				Home visits vs. child care centers				
DD-IV	-1.365***	0.025	0.227*	-0.684***	-0.493***	-19.102***	-53.501***	-92.162***
(whole sample)	(0.322)	(0.057)	(0.133)	(0.228)	(0.144)	(4.529)	(18.212)	(22.886)
N	2668	2707	2707	2706	2707	2704	2707	2704
DD-IV	-1.146***	0.003	0.224	-0.522*	-0.463**	-17.238**	-56.923***	-76.749***
(restricted sample)	(0.382)	(0.086)	(0.188)	(0.278)	(0.201)	(7.117)	(20.274)	(26.771)
N	1796	1824	1824	1823	1824	1821	1824	1822

Note: See the note of Table 2.5.

more when their child is exposed to an early childhood program, but the discontinuity is only significant at the threshold for child care centers.[27]

The estimation results presented in columns (5) to (8) of Table 2.7 are consistent with the picture that arises from the graphs. We find a significantly positive effect of child care centers on the probability that the mother works. The effect is large; 31 percentage points in the specification with controls for background characteristics. Home visits achieve the opposite. When children are served by home visits, their mothers are 19 percentage point less likely to work. For working hours we find that these go up by around 11 hours per week when the child is enrolled in a child care center, while these go down by 8 hours in case of home visits. For income of the mother and the household head, we find insignificant effects of home visits. The effect of child care centers on income of the mother and of the household head are both positive and significant. Their joint income increases by around 125 USD per month. The bottom rows of the table show that the effects obtained from the regression discontinuity designs carry over to the direct comparison of home visits and child care centers.

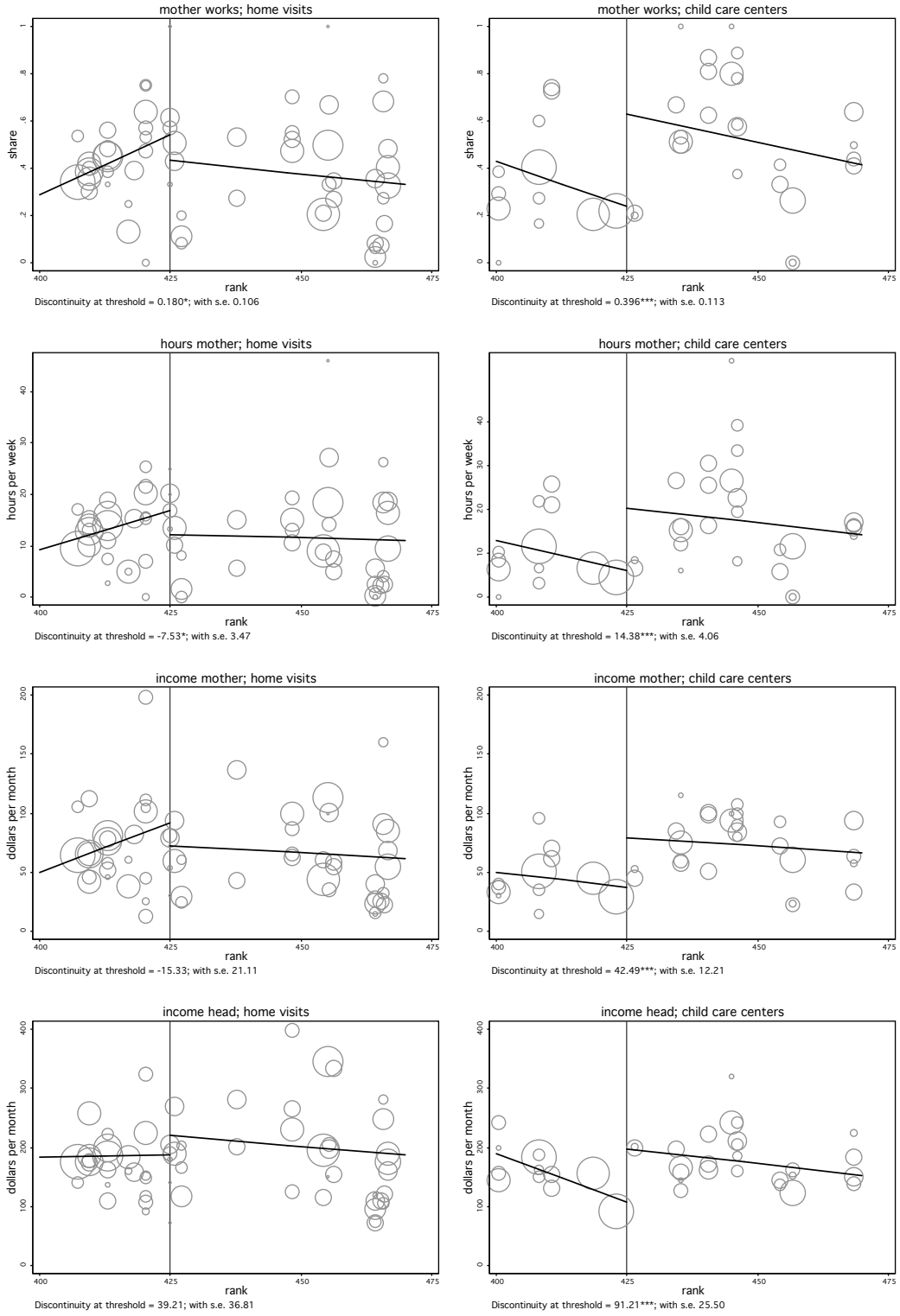
2.7 Putting the pieces together

The previous section presented impact estimates of home visits and child care centers on a range of outcomes. Some outcomes are potentially affected by other outcomes. For instance, the mother's psychological well-being may be affected by the outcomes of the child. In this section we present a simple model that captures how various outcomes interrelate. We focus on three endogenous outcomes: child outcome y_c (either cognitive outcomes or health), mother's psychological well-being pwb_m, and mother's hours of work hrs_m.

Child outcomes are assumed to be determined by the quantity and the quality of time inputs from the mother and from an early childhood intervention. We abstract from nutrition and income as separate inputs. Mother's psychological well-being is influenced by the outcomes of the child and by the mother's hours of work. Mother's hours of work in turn depend on the type of early childhood intervention. The quantity of the mother's time input (qnt_m) depends on her hours of work and the quality of the mother's time input (qlt_m) depends on her psychological well-being and the type of intervention (HV or CC). Obviously the quantity and quality of the time inputs

[27] In the graphs of the relation between score and mothers' labor market outcomes for child care centers, the observations just above the threshold tend to have outcomes very close to those of the observations just below the threshold. It should be considered, however, that together these two centers represent only 24 observations. Moreover, while results are presented for three labor market outcomes (participate, hours and income), these outcomes are by their nature highly correlated (the lowest pairwise correlation coefficient equals 0.57).

Figure 2.5. Relation between labor market outcomes and rank by type of intervention



Note: See the note of Figure 2.2.

(qnt_{int} and qlt_{int}) of the intervention depend on the type of intervention.

For simplicity we assume that all relations are linear. This gives the following seven equations

$$y_c = a_0 + a_1 qnt_m + a_2 qlt_m + a_3 qnt_{int} + a_4 qlt_{int} \tag{2.4}$$
$$pwb_m = b_0 + b_1 y_c + b_2 hrs_m \tag{2.5}$$
$$hrs_m = c_0 + c_1 HV + c_2 CC \tag{2.6}$$
$$qnt_m = d_0 + d_1 hrs_m \tag{2.7}$$
$$qlt_m = e_0 + e_1 pwb_m + e_2 HV + e_3 CC \tag{2.8}$$
$$qnt_{int} = f_0 + f_1 HV + f_2 CC \tag{2.9}$$
$$qlt_{int} = g_0 + g_1 HV + g_2 CC \tag{2.10}$$

Solving this system of equations, gives the following expressions for y_c and pwb_m:[28]

$$y_c = \frac{1}{1 - a_2 e_1 b_1}[K_1 + (a_1 d_1 c_1 + a_2 e_1 b_2 c_1 + a_2 e_2 + a_3 f_1 + a_4 g_1)HV + (a_1 d_1 c_2 + a_2 e_1 b_2 c_2 + a_2 e_3 + a_3 f_2 + a_4 g_2)CC] \tag{2.11}$$

$$pwb_m = \frac{b_1}{1 - a_2 e_1 b_1}[K_2 + (a_1 d_1 c_1 + \frac{b_2 c_1}{b_1} + a_2 e_2 + a_3 f_1 + a_4 g_1)HV + (a_1 d_1 c_2 + \frac{b_2 c_2}{b_1} + a_2 e_3 + a_3 f_2 + a_4 g_2)CC] \tag{2.12}$$

where K_1 and K_2 are constants. To be able to determine the signs of the derivatives of y_c and pwb_m with respect to HV and CC, we need to know the signs of the underlying parameters. Table 2.8 summarizes these signs, which are either based on an assumption ("A") or on a result reported in Table 2.7 ("T2.7"). We assume that $a_2 e_1 b_1 < 1$. The signs of the derivatives are then determined by the expressions in parentheses.

Table 2.8. Signs of model parameters

parameter	a_1	a_2	a_3	a_4	b_1	b_2	c_1	c_2	d_1	e_1	e_2	e_3	f_1	f_2	g_1	g_2
sign	+	+	+	+	+	-	-	+	-	+	+	-	+	+	+/0	+/0
source	A	A	A	A	A	A	T2.7	T2.7	A	A	T2.7	T2.7	A	A	A	A

Note: A means "by assumption", T2.7 means "based on Table 2.7".

[28]The expression for hrs_m is already given in equation (2.6) since there is no feed-back mechanism through which hours are affected by child outcomes or mother's well-being.

The sign of the derivative of y_c with respect to HV is determined by five terms. With the parameters signs in Table 2.8, the first four terms are positive and the last term is non-negative. Hence, home visits have a beneficial impact on child outcomes. This is also what we find in Tables 2.5 and 2.6. The sign of the derivative of y_c with respect to CC is also determined by five terms. Given the parameter signs in Table 2.8, the first three terms are negative, the fourth is positive, and the fifth is non-negative. When the negative terms are large enough (in absolute value) they can offset the positive terms. The zero impact on cognitive outcome in Table 2.5 and the negative impact on health in Table 2.6 suggests that this is the case. The first channel through which this operates is the increase in working hours of the mother, which by assumption reduces the amount of time the mother spends with her child, thereby reducing this input. The second channel is that an increase in mother's working hours increases mother's stress, which in turn has a negative impact of the quality of mother's time input. The third channel is that child care centers have a negative impact on mother's parenting quality. Together these three channels are apparently strong enough to undo any positive impact that the quantity and the quality of child care centers have on the outcomes of the child.

The sign of the derivative of mother's psychological well-being with respect to home visits is determined by five underlying terms. The signs of the first four terms are positive and the sign of the last term is non-negative. This is consistent with our finding that mother's psychological well-being increases when her child is enrolled in a home visit program. Also the sign of the derivative of mother's psychological well-being with respect to child care centers is determined by five underlying terms. The first three are negative, the fourth positive and the last one non-negative. Whenever $a_1 d_1 c_2 + \frac{b_2 c_2}{b_1} + a_2 e_3 < -a_3 f_2 - a_4 g_2$, the negative terms dominate the non-negative terms and mother's psychological well-being is harmed when her child is enrolled in a child care center. This is what we find in Table 2.7. The first mechanism through which this operates is that child care centers increase mother's working hours, this reduces the time input in the child and thereby the child's outcomes. Lower child outcomes harm mother's psychological well-being. The second mechanism is direct, working reduces mother's well-being. Finally, we find that mother's parenting quality deteriorates when the child is enrolled in a child care center. This is stressful for mothers, through the lower child outcomes that this causes. As it turns out, the three mechanisms are together strong enough to offset any positive impact that child care centers may have on the mother's well-being through the increase in child outcomes.

The analysis in this section highlights the mechanisms that cause the very different effects we find of home visits and child care centers on child outcomes and mother's psychological well-being. Home visits improve mothers' parenting styles while child

care centers worsen these. Child care centers increase working hours which causes stress in mothers, both directly and through the negative impact this has on child outcomes. Home visits instead reduce working hours.

2.8 Conclusions

The evidence on the effects of early childhood interventions in the context of developing countries is thin. In this chapter we provide evidence on the impact of child care centers and home visits on a broad range of outcomes: children's cognitive and motor development, children's health, parenting styles, mothers' labor supply and income and mothers' psychological well-being. Home visits and child care centers are both evaluated against no intervention through a regression discontinuity design, and are compared directly by combining the regression discontinuity design with a difference-in-differences approach (and matching).

Our results show that home visits have a positive impact on children's cognitive and motor outcomes, whereas child care centers have no impact on these outcomes. Home visits have a positive impact on children's health by reducing the probability to have anemia by one third. Child care centers result in children being underweight more often. Furthermore, home visits reduce mothers' stress and depression symptoms and make them more responsive towards their children. Child care centers do the opposite: they harm mothers' psychological well-being and reduce responsiveness. Finally, child care centers increase mothers' labor market participation and income, while home visits reduce mothers' labor market participation but leave family income unaffected. The two types of interventions thus represent a trade-off between child outcomes and mother's psychological well-being on the one hand, and labor market participation and income on the other hand. For a choice between the two programs it is also important that the per child cost of a child care center is almost five times as high than the per child cost of home visits.

Our findings are consistent with a framework in which children's outcomes are determined by the quantity and the quality of time spent with them by the mother and by the early childhood program, and in which the psychological well-being of the mother is determined by her working hours and the outcomes of the child. In this framework, child outcomes and mother's psychological well-being are adversely affected by child care centers through the negative effect these centers have on the mother's parenting style and through the increase of mother's working hours. Home visits do not have adverse effects since this intervention improves mother's parenting styles and reduce her working hours.

This discussion makes explicit that our findings are conditional on the quality of

the early childhood interventions included in our design. We emphasize that our analysis looks at the effects of programs that were above the minimum quality standards required to receive funding. Moreover, the home visit programs and child care centers that we evaluate are of the same quality level (measured by the scores that the proposals received in the contest for quality indicators). At the same time, lower quality of child care centers in Ecuador than those operated elsewhere might explain why we find negative effects of child care centers on children's development while studies for Norway and Germany report positive effects of child care centers on these outcomes (Havnes and Mogstad, 2011; Felfe and Lalive, 2010). Our findings for child care centers are, however, very similar to the results reported for Canada (Baker et al., 2008).

The trade-off that we identified poses a difficult choice to policy makers and funding agencies. Children and women in poor families in developing countries are both vulnerable groups. Home visits benefit children, whereas child care centers cause women to be stressed and depressed but are also likely to empower them by increasing their labor market participation and income. We trust that information about these conflicting interests are helpful in formulating and implementing efficient policies.

Appendix

Table A1: Linear probability model for being listed for home visits vs child care centers

	coefficient		s.e.
Boy	0.008		(0.017)
Age	-0.004		(0.004)
Age squared/1000	0.015		(0.042)
Household size	-0.028	**	(0.012)
Urban	0.149	***	(0.020)
Cash transfer	0.048	**	(0.019)
Mother's age	0.001		(0.001)
Schooling mother	0.014	***	(0.003)
Schooling head/10	0.001		(0.023)
Language score mother/10	0.004		(0.005)
Father present	-0.014		(0.026)
Mother present	-0.029		(0.050)
Indigenous	-0.057	***	(0.019)
Number of adolescents in household	-0.020	***	(0.008)
Number of adults in household	0.010		(0.018)
Number of old people in the household	-0.019		(0.041)
Mother is illiterate	0.018		(0.031)
R^2	0.09		
N	2707		

Note: Robust standard errors in parentheses. ***/** indicates significance at the 1%/5%-level.

Table A2: Additional specifications cognitive outcomes

	Older than 36 months			Younger than 60 months				
Specification	Memory	Fine motor	Language	Gross motor	Fine motor	Language	Social	Total
				Home visits				
No controls	0.193*	0.189*	-0.009	0.076	0.010	0.019	0.079	0.069*
	(0.103)	(0.108)	(0.140)	(0.055)	(0.020)	(0.027)	(0.051)	(0.036)
Linear rank, X	0.597***	0.913***	0.350***	0.204***	0.055	0.006	0.105	0.162***
	(0.119)	(0.138)	(0.131)	(0.076)	(0.043)	(0.042)	(0.077)	(0.058)
Spline rank, X	0.585***	0.891***	0.412***	0.151	0.057	0.020	0.152*	0.181***
	(0.129)	(0.155)	(0.147)	(0.090)	(0.046)	(0.047)	(0.085)	(0.065)
Cubic rank, X	0.549***	0.800***	0.376**	0.219**	0.074	0.023	0.205**	0.211***
	(0.138)	(0.137)	(0.149)	(0.091)	(0.050)	(0.048)	(0.097)	(0.068)
N	1510	1521	1514	1187	1192	1189	1192	1170
				Child care centers				
No controls	0.204	0.230	0.009	0.018	-0.025	-0.006	0.013	-0.034
	(0.192)	(0.142)	(0.324)	(0.039)	(0.061)	(0.062)	(0.086)	(0.082)
Linear rank, X	-0.182	0.305	-0.062	0.062	0.040	0.009	0.156	0.031
	(0.232)	(0.279)	(0.217)	(0.063)	(0.048)	(0.074)	(0.151)	(0.095)
Spline rank, X	-0.209	0.181	-0.080	0.072	0.053	0.047	0.169	0.049
	(0.262)	(0.224)	(0.251)	(0.059)	(0.044)	(0.056)	(0.143)	(0.097)
Cubic rank, X	-0.275	0.099	0.068	0.007	0.155***	0.149**	0.124	0.077
	(0.338)	(0.317)	(0.304)	(0.065)	(0.054)	(0.055)	(0.192)	(0.126)
N	770	773	767	542	540	540	543	532

Note: Each estimate comes from a separate IV-regression where a dummy for being at or above the funding threshold is the instrument. Background controls (X) are the variables included in Table 2.4. Robust standard errors in parentheses. */**/*** denote significance at a 10/5/1% confidence level.

Table A3: Additional specifications health outcomes

Specification	Anemia	Under weight	Below height
	Home visits		
No controls	-0.068	0.016	0.082**
	(0.046)	(0.015)	(0.039)
Linear rank, X	-0.210***	0.028	0.118**
	(0.060)	(0.029)	(0.051)
Spline rank, X	-0.188***	0.032	0.090
	(0.065)	(0.028)	(0.055)
Cubic rank, X	-0.159**	0.033	0.005
	(0.068)	(0.028)	(0.065)
N	1658	1787	1769
	Child care centers		
No controls	0.115***	0.043*	0.189**
	(0.035)	(0.025)	(0.082)
Linear rank, X	-0.006	0.102**	0.042
	(0.111)	(0.038)	(0.103)
Spline rank, X	-0.001	0.104***	0.065
	(0.111)	(0.035)	(0.084)
Cubic rank, X	0.051	0.102	0.236*
	(0.127)	(0.067)	(0.119)
N	763	872	870

Note: See the note of Table A2.