

Preschool and Child Development under Extreme Poverty

Evidence from a Randomized Experiment
in Rural Mozambique

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Abstract

This study analyzed the impact of a community-based preschool program on child development and schooling outcomes in high-poverty areas of rural Mozambique. Preschools were randomly assigned to 30 of 76 eligible communities. Using a panel survey of 2,000 households with preschool aged children, the study found that children who attended preschool experienced gains in cognitive development, communication, fine motor skills, and socio-emotional skills, scoring 0.33 standard deviations higher on a child development screening test. Preschoolers were 21 percentage points more likely to be enrolled in primary school, 14.9 percentage points more likely to enroll at the appropriate

age, and had higher cognitive and communication scores in first grade. Treatment effects were generally larger for children from vulnerable households, those with higher initial development levels, and those with longer exposure to treatment. The preschool intervention also generated positive spillovers by increasing the school enrollment of older siblings and labor supply of adult caregivers. At a cost of approximately \$3 per child per month, community-led preschools have the potential to be a cost-effective policy option for helping children meet their development potential even in the most resource deprived parts of the world.

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Preschool and Child Development under Extreme Poverty: Evidence from a Randomized Experiment in Rural Mozambique*

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1. Introduction

It is well known that the foundations for a healthy and productive future are formed in the early years of a child's life. Yet in 2010, an estimated 115.5 million children (81%) in Sub-Saharan Africa risked failing to meet their development potential because of poor health and poverty (Lu et al, 2016). Inadequate health and nutrition, cultural practices that limit communication between parents and children, and home environments with few books, toys, and other learning opportunities may all contribute towards inadequate cognitive growth and overall child development. These early deficits can have life-long consequences, including lower levels of school participation and performance, lower future earnings and income, increased reliance on the health care system and higher rates of criminality (Walker et al., 2001; Naudeau et al., 2010). The effects of poor development in the early years can thus be deleterious and long lasting, reinforcing the intergenerational transmission of poverty and constraining economic development.

Investments in early childhood development (ECD) interventions have been shown to be cost-effective and to have a higher rate of return than investments later in life (Heckman, 2008; Heckman, Stixrud, and Urzua, 2006). Evidence in the United States suggests a potential rate of return of 7-10 percent annually from high quality ECD interventions targeting vulnerable groups (Heckman et al., 2010; Rolnick and Grunewald, 2007), while a model of the long-term economic benefits of increasing preschool enrollment to 25% or 50% in every low-income and middle-income country showed high benefit-to-cost ratios ranging from 6.4 to 17.6 (Sudfeld et al., 2011). Furthermore, investments during early childhood are highly complementary with investments made later in life, making future investments more efficient and yielding significant benefits to both individuals and society (Engle et al., 2007). In the short to medium term, ECD interventions have been shown to enhance school readiness and related educational outcomes, improve physical and mental health, and reduce engagement in high-risk behaviors (Barnett, 2011; Nores and Barnett, 2010; Engle et al., 2007; Gormley et al., 2008). Significant long-term labor market returns of a home-based early stimulation intervention in Jamaica have also been documented (Gertler et al., 2014).

For low and middle-income settings, evidence on the effects of preschool come primarily from Latin America. Positive effects of preschool on schooling and child development have been demonstrated in Argentina (Berlinski et al, 2009), Bolivia (Behrman et al, 2004), Colombia (Bernal

and Fernández, 2013; Attanasio et al. 2013), and Uruguay (Berlinski et al, 2008).¹ Outside the Latin American context, the causal evidence on the effectiveness of preschool and its viability as a cost-effective model for improving child development outcomes is scarcer (see for example Bouguen et al, 2013; Arbour et al, 2016; Ozler et al, 2016; Behrman, Cheng and Todd, 2004; Rosero and Oosterbeek, 2011).

As such, the potential benefits as well as the costs and feasibility of investing in preschool across multiple communities and under conditions of extreme poverty remain largely open questions. This study helps fill this gap by conducting one of the first large-scale randomized experiments of preschool in an African context. We analyze the effects of a community based preschool intervention randomly assigned to 30 of 76 eligible rural communities in the Gaza province of Mozambique. At a cost of US\$3.09 per child per month, the program provided up to three preschool classrooms per community, community mobilization activities, learning materials, instructor training, and monthly parenting meetings. We collected a baseline survey of 2,000 households with preschool aged children just prior to the roll-out of the program in 2008. We additionally measured primary school performance on a sample of first graders and interviewed local community leaders. Two years later, we conducted a follow-up survey on the original sample of children plus cross sections of first graders and community leaders in the 76 evaluation communities.

We measure the effects of preschool on key dimensions of children's development and school readiness, including the cognitive (numeracy, working memory), linguistic (receptive language, use of gestures, sounds and movements), psycho-social and behavioral (personal and social) and physical (fine and gross motor skills, health and nutrition) domains. We then analyze the effects of preschool attendance on subsequent primary school enrollment and a teacher assessment of performance in first grade. To shed light on potential causal pathways, we explore heterogeneity analysis by the child's initial conditions, treatment duration, and analyze the effects of the program on child health and parenting practices. Additionally, given that preschools may free up caregiver time at home, we explore potential spill-over effects of the program on older siblings and caregivers.

¹ Existing preschool evaluations in Latin America have relied exclusively on quasi-experimental identification strategies (Leroy et al, 2012). Other preschool studies compare participating and non-participating children without establishing causal attribution, for example Mwaura et al., 2008 for Kenya, Uganda, and Zanzibar, and Rao et al., 2012 for Cambodia.

We find that children who attend preschool demonstrate large and significant improvements in cognitive and problem-solving abilities, communication and receptive vocabulary, fine-motor skills and socio-emotional and behavioral outcomes. As such, children are better prepared for primary school and outperform their peers in the control group on these dimensions. The preschool program has a large impact on transition to primary school. Children who attended preschool are 21.2 percentage points more likely to be enrolled in primary school and spend an average of 5.86 additional hours per week on schooling and homework related activities. Preschoolers are also significantly more likely to enroll in first grade by age 6, an important achievement in the Mozambican context where many children enroll in primary school well after the appropriate age. Once in primary school, preschoolers score higher on measures of communication and cognitive development. The effects of preschool on child development and schooling appear to be largest for the most disadvantaged children, those with higher initial cognitive capacity, and increases with treatment duration, suggesting that preschool has the potential to compensate at least partially for the detrimental effects of extreme poverty.

In addition to the direct effects on preschoolers, we find evidence of modest but positive spillovers from the program on school enrollment of older children and labor force participation of caregivers. Children 10 to 14 years old were 2.8 percentage points more likely to have attended school and reported spending fewer hours caring for younger children. Adult caregivers were 3.7 percentage points more likely to report working in the past 30 days (effect significant at the 10% level). These results suggest that center based models, where children are cared for out of the home, may produce added benefits compared to alternative home-based models by freeing up time for other household members.

The remainder of the paper is structured as follows. The next section describes the country context and preschool program. Section 3 presents the randomized evaluation design and sections 4 and 5 describe the data and identification strategy, respectively. In section 6 we present the main results, explore causal pathways, and discuss validity checks. Section 7 concludes.

2. Context and Intervention

This section provides a brief overview of the context and setting of the preschool intervention at the time of its implementation between 2008 and 2010. Mozambique is a Sub-Saharan African

country with a population of approximately 25 million people. Soon after gaining independence from Portugal in 1975 the country descended into a civil war that lasted from 1977 to 1992. By the end of the civil war, Mozambique was one of the poorest countries in the world. As of the early 1990s, Mozambique embraced a new constitution enshrining a market oriented economy and a multiparty political system with free elections. By 2010 the country was one of the fastest growing economies of the world, though GNI per capita was still just US\$460.² Among the list of countries surveyed by the United Nations Development Program's Human Development Report of 2013, Mozambique had the third lowest Human Development Index in the World, only higher than Niger and the Democratic Republic of the Congo. Poverty levels in rural areas are particularly severe, with over 57% of the population living below the official poverty line. At the same time, Mozambique has made substantial progress in expanding primary education, with net primary school enrollment rates increasing from 45% in 1998 to 95.5% by 2010. Yet children tend to enroll in school past the appropriate age, and many times struggle with the new social and academic environment, resulting in increased repetition and low academic performance.

The Southern part of the country, including the Gaza province where this study was conducted, had higher incomes and better human development outcomes compared to other provinces in the central and northern areas of Mozambique. However, the province was also one of the most severely affected by the country's civil war. Partially due to high migration rates of adult males for employment in the mining sector, the province had the highest rate of young adults living with HIV-AIDS (Crush et al, 2010). One-quarter of the Gaza population aged 15 to 49 was HIV positive, while the national rate was estimated to be around 11% (Instituto Nacional de Saúde et al. 2010). Women were more severely hit by the HIV epidemic, with a prevalence rate of 30% in Gaza province.

While population based child development indicators in Mozambique are scarce, the 2011 Demographic and Health Survey (DHS) reported child growth in terms of height and weight.³ Nationally, 42.6% of children under age five were stunted, 14.9% were underweight and 5.9% were wasted. The conditions in Gaza province were relatively better off, with 26.8%, 6.3% and

² GDP growth has averaged around 7% per year in the period 2005-2015 (<http://data.worldbank.org/country/mozambique>).

³ The positive association between children's linear growth and cognitive development is well documented (Sudfeld et al, 2015).

1.0%, respectively⁴ (Ministério da Saúde, 2013). However, in our sample of 2,000 children ages 3 to 5 from 76 poor rural communities, pre-program growth indicators showed that 42% of children were stunted, and 5% of children wasted, suggesting that our study population more closely reflected the national average. Nationally representative statistics on child development outcomes other than growth were not available at the time of this study. However, standardized child screening tests from our baseline survey showed that around half the children in the sample were at risk of delays in fine motor skills and problem resolution, and more than 20% scored below age-appropriate levels in communication (Bruns et al, 2010).⁵

Baseline descriptive statistics of the study population are presented in Table 2. Most children in the sample lived in poor households, dependent on subsistence agriculture or informal employment, and 10 percent of children in the sample were orphaned, primarily single parent. Caregivers had only 3.3 years of education on average, 38% could not read or write, and 51% of caregivers did not speak Portuguese (the country's official and primary language for education). Furthermore, cultural practices and norms may have played a role in limiting caregivers' interactions with children and thus children's opportunities for cognitive development and school readiness. At baseline, only about half of caregivers reported reading, drawing objects or playing games with children at home.

While there is a multiplicity of demand side constraints that may limit investments in human capital of preschool aged children, in 2008 the supply of pre-primary education services was virtually inexistent in rural Mozambique. Existing preschools were concentrated in urban and more affluent areas, and available national estimates put the proportion of children enrolled in preschool at the time of the intervention at about 4%.⁶ To help address the lack of child development services for preschool aged children in rural Mozambique, the non-governmental organization Save the Children began implementing a community based preschool program in three districts of the Gaza Province starting in 2008.⁷ The program focused on early stimulation, emergent literacy and numeracy instruction and psychosocial support, with the objectives of improving children's cognitive, social, emotional, and physical development, and facilitating transition to primary

⁴ The DHS also showed that nationally, 91.7% of newborns were breastfed, and the median duration of exclusive breastfeeding was 3.5 months, well below the recommended 6 months. The situation in Gaza is comparable.

⁵ With no country specific reference group, we compare to available reference populations.

⁶ Starting in 2014, a national preschool program rolled out to 84,000 children in 600 communities.

⁷ The preschool model was initially piloted in 12 communities starting in 2005. Based on this initial experience and thanks to additional financial resources, the model was scaled up to 30 new communities in early 2008.

school. In addition, the program organized monthly parent group meetings to strengthen positive parenting practices in the home.

Funding constraints limited the intervention to a maximum of 30 communities. Save the Children provided the seed capital and technical assistance to build and equip the preschools, train instructors, and implement a standardized curriculum. Each preschool was built with one to three classrooms, washrooms, and a playground.⁸ Communities donated land, labor, and locally available construction materials, and appointed a 10-member committee to manage and supervise preschool activities.⁹ Given the scarcity of qualified instructors in the area, preschool teachers were not formally trained educators. Instead, instructors were recruited from within communities, provided basic training and supervision by Save the Children, and paid a nominal fee of US\$10 per month. Instructors were primarily female, more educated than the average caregiver in our sample (6.1 years of education compared to 3.4), and many had children of their own enrolled in the preschool.

Preschools operated 5 days a week for 3 hours and 15 minutes per day, following a structured daily routine designed to stimulate child development through play and learning activities.¹⁰ Each classroom held up to 35 children and was staffed by two instructors. While enrollment was limited to children between the ages of 3 and 5 years, classrooms were mixed by age and gender to promote peer-to-peer interaction. The primary language of instruction was Changana, the local vernacular, and the curriculum gradually introduced Portuguese into learning activities to help children prepare for primary school.

To complement classroom activities with additional stimulation and caregiving practices at home, parents and caregivers of enrolled children committed to participating in monthly meetings to discuss child development topics such as health, nutrition, and literacy.¹¹ Meetings were facilitated

⁸ A detailed description of the preschool intervention is given in Supplementary Materials section 1. A total of 67 classrooms were financed through the program. Physical requirements included 1.2 to 1.5 meters of space per child, adequate ventilation and light, and clean and dry floor surfaces. Classrooms were built using both traditional and conventional building materials and were typically built as single standing rooms with cement floors, wood or straw walls and thatched or tin roofs.

⁹ Preschool management committees were appointed by the community. Each committee was composed of a president, secretary and treasurer, and was assisted by other community members responsible for mobilizing the community to assist with construction, participate in caregiver meetings, and conduct preschool maintenance activities such as cleaning and providing safe water.

¹⁰ See Supplementary Materials Section 1.2 for the daily schedule of activities.

¹¹ Meetings were open to anyone in the community. Parents of preschoolers were meant to attend meetings as a condition to enrolling their children in the program, though attendance was not strictly enforced in practice.

by Save the Children staff with assistance from preschool instructors and community health workers, following an appreciative inquiry approach in which knowledge is built from existing positive parenting practices and harmful practices are brought to light and modified with strategies such as the use of positive deviance to model new behaviors.¹²

The program was implemented in three districts of Gaza Province (Manjacaze, Xai Xai and Bilene) where Save the Children had an established operational presence. Program requirements narrowed eligibility to rural communities with between 500 and 8,000 residents, located within operational areas of sufficient geographic proximity so program field teams could travel between assigned communities in a single day.¹³ As a pre-condition for funding, communities committed to the contribution of land, materials, and labor. The intervention rolled out in 2008 with the formation of preschool committees, recruitment and training of teachers and construction of classrooms. Some communities initiated teaching activities prior to completion of the physical infrastructure, meeting outdoors or in other community structures while the preschool facilities were built.

Enrollment was restricted to children between three to five years old with residence in the community, though age and residency requirements were difficult to monitor and were not always strictly enforced. Enrollment in the preschool program was voluntary and participating parents were encouraged to send their children to preschool daily, to attend the monthly parenting meetings, and help with preschool maintenance activities such as supplying clean drinking water and cleaning. Monetary contributions from families were minimal, as the program covered the costs of instructor stipends and basic materials during the first two years of operations. While in principle the program was targeted to the poorest and most vulnerable children in each community, in practice we observe that children who enrolled in preschool were more likely to speak Portuguese, scored higher on some child development indicators, and tended to have more favorable nutritional indicators. We also found differences in caregiver characteristics and behaviors in our baseline survey, with parents of enrolled children more likely to speak

¹² Positive deviance models behaviors on the successful strategies of peers in the community.

¹³ The population criteria were established to reach enough children for at least one classroom at the lower limit, while enabling community mobilization in larger communities. The program financed 5 field teams, each of which was responsible for implementing the program in 6 communities. To reduce travel time and costs, each group of 6 treatment communities needed to be located within sufficient proximity so that a field team could travel between its assigned communities within the same day. Operational areas corresponded closely with administrative posts, the intermediate administrative unit between district and community.

Portuguese, read and write, and report pro-active parenting practices such as playing games with the child.¹⁴

3. Experimental Design and Sample

As discussed above, funding constraints limited the project to a total of 30 intervention communities, which were assigned at random within the pool of eligible communities in the intervention districts. Following operational requirements set by the program, the random assignment protocol was established in the following steps. First, the program compiled a list of all eligible communities in the three districts¹⁵ and identified “operational areas” based on the geographic proximity and access between communities. To maximize the number of eligible communities in the sample, the five operational areas with the largest number of communities were selected, and each area was assigned six treatment communities. Within each operational area, communities were stratified by population size, forming blocks of two or three communities. For each block, one treatment community was assigned at random, resulting in 30 treatment communities and 46 control communities. Six of the original 46 control communities turned out to be neighborhoods in treatment communities where a preschool was built, and were re-classified to their treatment counterparts in our analysis.¹⁶ We test for and confirm that our main results are robust to the ex-post re-classification of these six control communities.¹⁷

The household survey collected data on a random sample of 2,000 households with preschool age children in the 76 evaluation communities. In the absence of a household level sample frame, we conducted a door to door census to identify households with at least one child in the preschool-eligible age range of 36 to 59 months. We then drew a random sample of 23 households with eligible children per community. In addition, in each of the 4 largest treatment communities where oversubscription to the program was likely,¹⁸ an additional 63 households were selected, yielding

¹⁴ See Supplementary Materials Table 7.

¹⁵ The list of communities was based on the best available information at the time of the baseline survey. With no official roster of communities in the three districts, a consultant was hired by the program to update existing lists based on interviews with officials at the administrative post level.

¹⁶ The sample selection, randomization procedure and the ex-post corrections of neighborhoods is discussed in detail in Supplementary Materials Section 3. Re-classification was possible thanks to precise geo-location data collected on the original sample of 76 treatment and control communities in 2014.

¹⁷ Results are presented in Supplementary Materials Section 7.

¹⁸ Individual level randomization was initially proposed for communities with oversubscription, though ultimately this was not systematically implemented and was abandoned as an evaluation strategy. Nevertheless, oversubscription did occur in several larger communities.

a total sample of 2,000 households. In our analysis we re-weight the data with community level population sample weights equal to the inverse probability of selection, though results are generally robust to the exclusion of weights as would be expected from block randomization based on community population size.¹⁹

In each sampled household, we collected a detailed baseline survey including child development tests and anthropometric measurements for one preschool aged child per household, identified as the “target child.” In households with more than one preschool aged child, the youngest child was selected. We additionally interviewed the target child’s primary caregiver and the head of household to collect demographic and socio-economic information about parents, caregivers, and other household members. In addition, in each community we conducted a community leader survey and a primary school survey, interviewing school principals and first grade teachers to collect school performance indicators on a sample of 1st graders. Baseline characteristics are balanced between treatment and control communities, with no significant differences for community infrastructure, child characteristics (sex, age, language, orphan, health status or anthropometrics), child development tests (described in detail in section 4) or caregiver and household characteristics (Table 2).²⁰

In 2010, approximately two years after the start of the program, we conducted a follow-up survey on the panel of target children and their households as well as the current community leader and a cross-section of 1st graders in the same primary schools interviewed at baseline. We also visited the preschools in treatment communities to collect information on the status of the program’s operation. An intensive tracking effort was made to locate the target child and minimize sample attrition. If the child had moved from his or her original place of residence we attempted to interview the child (and their current household) so long as he or she maintained residence in Gaza Province (including outside the three intervention districts) or had moved to the capital city, Maputo. Overall, we successfully located 94.9% of the baseline sample, for an average attrition of approximately 2.5% per year and with no differential attrition between treatment and control (94.8% re-contact in treatment, 94.9% re-contact in control).

¹⁹ The modified Breusch-Pagan test suggested by Solon et al (2013) indicates the presence of heteroskedasticity associated with cluster sizes. In this case weighting can improve the precision of the estimates. Unweighted estimates are presented in Supplementary Materials Table 28.

²⁰ See Supplementary Materials Table 6 for baseline balance of community level variables.

Figure 1 shows preschool enrollment over time as reported by primary caregivers for children ages 3 to 9 in 2010, in the treatment and control groups. We observe that, prior to 2007, preschool enrollment was virtually non-existent for children in both groups. There is a slight increase in preschool enrollment in treatment communities in 2007, though still under 4%.²¹ Starting in 2008 when the program was fully operational, we observe a sharp increase in enrollment among children in treatment communities, with 29% of children enrolled by January 2010. We also observe a slight positive trend in preschool attendance in control communities in the period between 2008 and 2010, though total enrollment rates never surpass 6%. We attribute this to the construction of 6 government and church preschools in control communities over the same period, but we cannot rule out some contamination from program preschools.

To confirm program effects on preschool participation we disaggregated enrollment by age.²² We found significant differences in enrollment rates for children in the cohort of 3 to 7 year old children who were eligible for program participation in the period between 2008 and 2010, but no differences for children 8 to 11 who were at least 6 years old in 2008 and thus too old to enroll in preschool. For the sample of target children (3 to 5 years old at baseline), enrollment in treatment communities was 41% compared to 8% in control, resulting in a treatment effect of 33 percentage points in preschool enrollment. Among children enrolled in preschool, on average children attended 4.9 days a week, for a total of 3.7 hours per day. Average travel time from home to the preschool was 20 minutes and average reported fees were 5 meticals (US\$0.16) in the treatment group and 23 meticals (US\$0.76) per month in the control group.

We also asked caregivers of children that did not enroll in preschool about access to a preschool in their area. Approximately 77% of households in treatment communities reported having access to preschool compared to 27% in control communities. This result suggests that about a quarter of households in the treatment communities were either unaware of the preschools in their community or viewed them as being too far or otherwise inaccessible. When analyzing the primary reason given for not enrolling their preschool-aged child in preschool, the three most common

²¹ The baseline survey was timed prior to the construction of any preschool classrooms, however some communities had already started the community mobilization process and had recently begun operating preschools in outdoor or temporary spaces at the time of the baseline survey. Some of the reported preschool participation in the pre-program period may also be attributed to recall bias. However, it is likely that some children in treatment communities had already been enrolled when the baseline survey took place. Given the very short exposure to treatment on this group of children, we do not expect this would significantly alter longer term measures of child development collected at baseline.

²² See Supplementary Materials Table 8.

reasons were that the distance to the preschool was too great, that the child was too young (suggesting misinformation of eligibility rules or a perception that younger children are better off staying home) and that preschool was too expensive. Five percent of non-participating households in treatment areas reported applying to the preschool but not being accepted, while 13% applied but were not accepted in control areas.

4. Measuring Child Development

The primary objective of the intervention was to improve children's development along the domains of cognitive, social, emotional, and physical development, thus facilitating transition to primary school. We applied a set of standardized tests to measure cognitive ability (including problem-solving skills, memory, and early math skills), gross motor skills (e.g., running, jumping), fine motor skills (e.g., picking up objects, holding a pencil), language and communication (e.g., production and understanding of words, ability to identify letters), and socio-emotional development (e.g., getting along with peers and adults, following directions and cooperating, capacity to regulate emotions positively in stressful situations) (Fernald et al, 2009). We also collected children's anthropometric measurements (height and weight) and caregiver-reported morbidity.

The specific child development tests were based on adapted versions of: (i) the "Ages & Stages Questionnaires®" (ASQ),²³ (ii) the "Teste de Vocabulario por Imagens Peabody" (TVIP),²⁴ and (iii) the Early Development Instrument (EDI). All tests were applied at baseline²⁵ and again at endline,²⁶ using age specific versions of the tests when appropriate. The adapted versions of the ASQ and TVIP were collected on the panel of target children. The adapted version of the EDI was collected on a repeated cross section of a random sample of 20 first graders in primary schools in treatment and control communities.

²³ Ages & Stages Questionnaires (ASQ), Second Edition: A Parent-Completed, Child-Monitoring System, by Diane Bricker and Jane Squires. Copyright © 1999 by Paul H. Brookes Publishing Co., Inc. www.agesandstages.com. Used with permission of the publisher.

²⁴ The TVIP is an adaptation of the Peabody Picture Vocabulary Test (PPVT).

²⁵ See Bruns et al. (2010) and Naudeau et al. (2011) for a detailed discussion of findings at baseline.

²⁶ A fourth test, the Strengths and Difficulties Questionnaire (SDQ) was added to the endline survey. We do not present the results due to a coding error present in the data which impaired the authors' ability to carry out meaningful and reliable analysis.

The ASQ is a child monitoring system used to assess whether children have reached certain developmental milestones across the domains of language, cognitive, gross motor, fine motor, and socio-emotional development. For this study, the questionnaire was translated into Portuguese and adapted for the local context. The adapted version of the ASQ was administered in Changana.²⁷ Some questions were asked directly to the target child, while other questions involving child behaviors that are difficult to observe in the context of a household visit were asked to the child's mother or caregiver. Each domain included a series of individual questions, and was scored based on the ability of the child to perform the task in question. Scores for each domain were aggregated to form a total score and sub-score by domain.

The TVIP is a test of receptive language applied to all target children in the sample. The TVIP was originally adapted and normalized for Spanish speaking populations in low-income settings and has been widely used in Latin America. In the test, the child was shown a series of 4 pictures or items at a time (e.g., fork, table, dog, doll). The surveyor asked the child to point to one of the pictures (the doll, for example) and then recorded whether the child pointed to the correct picture. The test stopped when the child made 6 errors within 8 consecutive responses. For this study, the TVIP was translated into both Portuguese and Changana. All target children were given the test in both languages, with Portuguese being administered first.

In addition to raw TVIP scores, we analyzed standardized scores using age specific norms published by the test developers. The norms used a sample of 1,219 Mexican children and 1,488 Puerto Rican children (Dunn et al, 1986) as reference. According to those norms, the age specific mean is always 100, and one standard deviation is 15, such that a score of 70 is two standard deviations from the mean of the reference population of Mexican and Puerto Rican Children. As observed in Figure 4, as of 60 months the mean TVIP score falls well below the 70-point mark. As a point of reference, children aged 66 months in our sample performed on average close to the 25% of poorest children from the sample of young and poor Ecuadorian families in a study by Paxson and Schady (2007). However, it is important to highlight that the TVIP was not normed for the Mozambican population and that the translation process (coupled with a lack of adaptation of specific items or objects not necessarily familiar to children in our sample) may have altered the level of complexity and therefore children's overall scores. As a result, cross-country

²⁷ Changana is a vernacular language. Therefore, it was important to have a standardized written version in Portuguese before a common Changana translation could be agreed upon by all surveyors (who spoke both Changana and Portuguese but not English).

comparisons at baseline were difficult to establish and indicative only, while follow-up scores (and the extent to which they differed across the treatment and control groups) provided meaningful and reliable information about the potential impact of the intervention.²⁸

The Early Development Instrument (EDI) (Janus & Offord, 2007) was completed by a first grade primary school teacher²⁹ who reported information on a random sample of 20 first graders enrolled in his or her class.³⁰ While potential biases in teachers' reporting (on the basis of socio-economic background, for example) can be a legitimate concern, the reliability and validity results of studies conducted with the EDI in diverse areas of Canada and in British Columbia (where a potential racial bias towards Aboriginal children was considered possible) dispute this contention (see a summary of these studies in Janus et al., 2007). For the purposes of this study, the EDI was translated into Portuguese, and some of the items were dropped or adapted to fit the local context.

We aggregate child development outcomes into indices and performed factor analysis when appropriate, as in the case of cognitive development and parenting. For other cases, we aggregate outcomes as in Katz et al (2001), by first subtracting the mean and dividing by the standard deviation of each outcome, and then averaging for all outcomes that compose the index.

5. Estimation Strategy

We first present intention to treat (ITT) estimates of the effect of offering preschools in treatment communities. Given that about 41% of eligible target children enrolled in preschool, the ITT estimate is a weighted average effect of enrolled and unenrolled children in treatment areas. The ITT estimate represents the relevant treatment effect from the point of view of the policy maker interested in replicating this intervention model in similar contexts, where some parents do not

²⁸ The level of cultural appropriateness and complexity of specific items would have equally impacted children in the two groups. Therefore, any remaining difference can be attributed to the intervention.

²⁹ In each school the survey team interviewed the principal and administered the EDI with one first grade teacher. In schools with more than one first grade teacher, the survey field supervisor selected one first grade teacher randomly. Once the teacher was selected, the supervisor randomly selected 20 first graders using a random table. The supervisor then filled in 3 questionnaires (i.e., for the first 3 first grade students) with the teacher to familiarize the teacher with the instrument. The supervisor left the 17 remaining questionnaires with the teacher, for him/her to complete, and returned within 2 weeks to collect all completed surveys.

³⁰ For the EDI we observe only the subset of children who enroll and are attending primary school. Given that the preschool program had a large and significant effect on primary school enrollment in treatment communities, the composition of first graders in treatment communities changed relative to controls. Evidence from the household survey indicates that the preschool intervention led more disadvantaged children to enroll in primary school, so results of the EDI are arguably lower-bound estimates of impact given a larger proportion of disadvantaged children in treatment community primary schools. Unfortunately, we do not have detailed socio-economic and demographic data on the sample of primary school children to confirm the direction of the potential sample composition bias.

enroll their children based on personal preferences, information, capacity constraints or other reasons. The basic regression model for the ITT estimator is:

$$Y_{ijt} = \alpha + \beta_1 T_j + \sum_{n=2}^N \beta_n X_{nit-1} + \sum_{j=1}^J \phi_j + \varepsilon_{it} \quad (1)$$

where Y_{ijt} is the outcome for individual i in community j at time t . T_j is an indicator variable for the treatment status of the community, based on random assignment. X_{nit-1} are a series of n individual and household level baseline controls included to reduce residual variance, ϕ_j are block-level fixed effects based on the random assignment protocol (district, administrative post and block), and ε_{it} is the random error. We estimate all regressions using population weights³¹ and robust standard errors, clustered at the community level. The key parameter of interest is β_1 , the causal effect of offering preschool in treatment communities.

Our second estimate of interest is the average impact of the program on children who enrolled in preschool. If preschool enrollment is endogenous, depending for example on the preferences and information of parents, then a simple regression of outcomes on an individual child level indicator for preschool attendance will yield a biased estimate of the impact of preschool attendance. To identify the unbiased effect, we use an instrumental variables (IV) approach, instrumenting individual preschool participation status with the randomized treatment status at the community level. We estimate a two stage least squares model:

$$Y_{ijt} = \eta + \gamma_1 \hat{D}_{ijt} + \sum_{n=2}^N \gamma_n X_{nit-1} + \sum_{j=1}^J \lambda_j + \xi_{it} \quad (2)$$

$$\hat{D}_{ijt} = \alpha + \theta_1 T_j + \sum_{n=4}^N \theta_n X_{nit-1} + \sum_{j=1}^J \phi_j + \varepsilon_{it} \quad (3)$$

where \hat{D}_{ijt} is an indicator variable equal to 1 when child i attended preschool and 0 otherwise. Our key parameter of interest is γ_1 , the local average treatment effect (LATE) interpreted as the effect of preschool for the subset of children who enroll in preschool thanks to the program. For the purposes of our analysis on a binary enrollment variable, we classified a child as having participated in preschool if they were reported to have enrolled and attended any length of time.

³¹ Sampling weights are calculated as the inverse of the probability of selection based on the sample design. Estimates are robust to weighting (see Supplementary Materials Table 28).

In addition, to capture the effects of differential exposure, we analyzed the number of months a child enrolled in preschool as a proxy for treatment intensity. We implemented a similar IV approach, instrumenting the number of months a child attended preschool T_{ijt} by the random allocation of preschools at the community level.

Another parameter of interest is the average effect of the Treatment on Treated (TOT), that is, the average effect of attending preschool. To interpret the IV estimate as the TOT, however, we required no preschool enrollment in control communities (Bloom, 1984). Yet 8% of target children enrolled in preschools in control communities. This attendance was due primarily to the construction of 6 non-program preschools,³² rather than enrollment of children from control communities in Save the Children preschools. We added a dummy variable to control for those communities in the regression analysis, and interpreted the IV estimates as LATE instead of TOT effects. Nonetheless, we propose three additional approaches to validate our results and approximate a TOT in the presence of potential treatment contamination in control communities.

First, taking advantage of the block randomization procedure, we identified and dropped from the analysis entire blocks where preschools were built by churches or other NGOs in control communities, thus reducing the number of blocks to 23. Limiting the analysis to this subset of blocks, average preschool enrollment in control communities fell to 4%.

Second, we redefined the participation dummy variable to include as compliers only the children enrolled in preschool and who live in a treated community. In other words, we replaced D_{ijt} by D'_{ijt} that is equal to one if and only if $D_{ijt} = 1$ and $T_j = 1$ in equations 2 and 3. As we did not identify any preschools other than those built by Save the Children in the sample of treated communities, we are confident that preschoolers in treatment communities attended a Save the Children preschool. In this set up, enrollment is zero in control communities by construction. Henceforth, it is an alternative, albeit likely lower bound approximation of the true TOT.³³

³² Through additional field work conducted in 2014, community leaders confirmed that two communities had existing preschools before 2008 and four other control communities had preschools built between the period of 2008-2010. These preschools were managed by other NGOs or Churches, and not Save the Children. One additional community, Muwawasse, had enrollment rates above 25% although a local preschool was not confirmed by the community leader. See Supplementary Materials Table 5.

³³ To see why this alternative is a lower bound to TOT we note that the $TOT = [E(Y|T=1) - E(Y|T=0)] / [E(T|Z=1) - E(T|Z=0)]$. Assuming $E(Y|T=0)$ under full compliance is greater than $E(Y|T=0)$ with treatment contamination in control communities, then our estimated LATE is a lower bound estimate of the true TOT.

Third, we used GPS data to calculate the distance from a child's house to the nearest preschool built by Save the Children.³⁴ Figure 2 shows preschool participation by distance to the nearest Save the Children preschool. Enrollment clearly fell with distance and no child travelled more than 5 km to a Save the Children preschool. For the GPS analysis, we ignored the community treatment status and used the distance between a child's home and the nearest Save the Children preschool as an instrument for preschool participation. Mechanically, this means replacing T_j by the continuous distance variable S_{ij} in equation 3. The estimated treatment coefficient is the average effect of attending preschool for those affected by the proximity to a Save the Children preschool. These likely included all enrolled children in treatment communities and the set of children in control communities who attended a Save the Children preschool. We estimated program effects using these different constructs of treatment assignment and verified that results were robust to the definition of treatment assignment.³⁵

6. Results

6.1. Child Development

We begin by analyzing the aggregate ASQ score, our most comprehensive measure of child development, represented as a z-score transformation of the aggregate score in standard deviations from the mean of the control group. Table 3 presents the results of the ITT and IV regression specifications.³⁶ Each coefficient is estimated from a separate regression. The intent to treat (ITT) effect in model (1) represents a 0.184 standard deviation (σ) increase in the average total ASQ score from offering the program in treated communities (significant at the 1% level). The IV estimate in model (1), interpreted as the LATE on children enrolled in preschool because of the program's presence, is an increase of 0.37σ in the total development score. Effects are positive and significant for the sub-domains of communication, problem solving and precise motor coordination, in the range of 0.30σ to 0.35σ in the IV models (columns 2 through 4). The exception

³⁴ GPS data was collected at baseline and endline, as well as in a short re-contact survey collected in 2014. Of the 1,897 households with complete surveys, 1,529 households have valid GPS locations.

³⁵ See Supplementary Materials Sections 3 and 7.

³⁶ For all tables, we present the control complier mean as a base rate to assess the program impact of the program for the relevant group of children that is affected by the policy. We present an approximation of the implied mean outcome for individuals in the control communities that would have enrolled their child in a preschool if they had the possibility, by assuming the proportion of always takers is low. We calculate the control complier mean by subtracting the estimated effect from the mean of the group of enrolled children in treated communities. For all ASQ domains, our approximation of the control complier means imply that the group of children who would have enrolled in preschool in control communities have lower development scores than other children in their communities.

is gross motor coordination, for which there is a positive but insignificant effect of preschool participation.

Table 4 reports results on receptive vocabulary as measured by the TVIP. We report effects on the raw score, within sample standardized score, and standardized score as per the test developers. While all three coefficients are positive, the raw score is estimated imprecisely. Effects on the standardized scores are positive and significant, showing a gain of 0.258σ for children who attend preschool.³⁷ Preschool increased an average participant's TVIP normed score³⁸ by 1.8 points (significant at 5%), an increase of about 3% relative to the control group. Figures 3 and 4 plot the raw and the normed TVIP scores by age for treatment and control groups (Changana version of the test shown). Consistent with the regression results, we observe higher scores for children in treatment communities throughout the distribution of ages. One concern with the use of the normed TVIP score is censoring, since for each age there is a minimum raw score that can be normed.³⁹ About 50% of all children in our sample had censored normed scores, and the probability of censoring increased with age (Figure 5), which could downward bias the estimate of program effect, if positive. There was no effect of the program on the probability of censoring (column 4), suggesting that the sub-sample of uncensored observations is orthogonal to treatment. The program effect on the TVIP normed score for the uncensored sample increases to 3.18 points (column 5).

Results of the EDI, collected on a cross-sectional independent sample of children enrolled in the first grade, are reported in Table 5.⁴⁰ In first grade, children who attended preschool have a 0.301σ increase in physical health, a 0.373σ increase on the domain of communication and general knowledge, and a 0.429σ increase in the cognitive domain score. While the estimated impacts on the domains of social competence and emotional maturity are large, results are estimated imprecisely and are not statistically significant at conventional levels. These results suggest that gains in child development achieved in preschool carry over into the first grade, and led to improved cognitive and communication performance in primary school.

³⁷ We calculate the z-score of the raw TVIP score for each child's age in months following Schady et al (2014) and Paxson and Schady (2007).

³⁸ Based on the test developer's tables.

³⁹ For example, a raw score of 1 translates into a normed score of 55 for children aged 60 months, which is the same normed score for all children aged 79 months with a raw score below 16.

⁴⁰ See Supplementary Materials Section 6 for item by item responses. Items with statistically significant treatment effects include being interested in mathematics, being able to count, ordering objects, recognizing geometric shapes, writing simple words, the overall social-emotional development, the ability to get along with peers, and the probability of comforting other children. Supplementary Materials Table 28 shows the estimates without the inclusion of controls.

Overall, the results from child development tests applied to children and caregivers in the household (ASQ and TVIP) and to teachers in primary school (EDI) consistently demonstrated robust positive effects of preschool on child development as measured in the domains of cognition, communication, precise motor and socio-emotional development of young children. To obtain an aggregate measure of preschool's effects on child development, we combined the ASQ and TVIP into a single summary variable via factor analysis, summarizing the 5 ASQ domains and the internally standardized TVIP score into a "child development factor". The first factor ("principal", or "g") explains 92% of the variance. As shown in model 1 of Table 9, the presence of a preschool in the community increases the mean index by 0.17σ , while attending a preschool increases the index by 0.337σ .

6.2. Schooling

By stimulating child development, the preschool program aimed to improve school readiness and facilitate the transition of children into primary school. Table 6 presents the ITT and IV impacts of preschool on the probability of being enrolled in primary school at the time of the follow-up survey, of ever enrolling in primary school, enrolling at the appropriate age, and of dropping out of primary school. Children who enrolled in preschool had an increased likelihood of being enrolled in primary school at the time of the survey of 21.2 percentage points and an increased probability of ever enrolling of 18.2 percentage points. Particularly important in the Mozambican context is that preschool increased the probability of enrolling at the appropriate grade for age (defined as 6 years old in 1st grade). Children who attended preschool were 14.9 percentage points more likely to enroll in school at the appropriate age, a relative increase of 44.3% compared to the control. The effect of preschool on primary school dropout was negative but not significant. This is not surprising given that at endline children had only a short exposure to primary school, and dropout rates are below 6%. We also calculated an aggregated schooling index, summarizing those outcomes in a single variable. Preschool attendance is associated to an increase of 0.36σ on the aggregated schooling outcome (Table 9, model 2).

In addition to primary school enrollment, we measured the amount of time spent by children on school related activities as reported by the child's primary caregiver. Table 7 analyzes the impact of preschool on time use. We observe that time reported on schooling and homework activities increased by 5.89 hours per week for children who enrolled into preschool, above the average of

15.7 hours spent by children in the comparison group. While the other time categories were measured imprecisely and not statistically significant, based on the magnitude of the estimated coefficients it appears that increased time on school related activities may have come at the expense of “other activities” and work, and not important activities for children’s overall development such as play or sleep.

6.3. Child Health

Program participation may have affected child health by instilling self-care practices such as hand washing (promoted as part of the daily routine at preschool) and changing care giving practices of parents and caregivers through community meetings.⁴¹ On the other hand, increased daily contact with other children could have also facilitated the transmission of infectious diseases such as the common cold. Table 8 presents impacts of the program on self-reported health outcomes, as reported by caregivers for the Target Child. Children were 14.5 percentage points more likely to be reported as sick in the last 4 weeks (model 1), primarily having had a cough (model 4). This increase likely reflected the healthy maturation of children’s immune systems in reaction to exposure to a range of pathogens in the context of a group setting in the preschool and primary school context. We did not find significant health effects on other self-reported measures of illness. Additionally, we found no differential effects between treatment and control groups on indicators of hygiene practices and healthcare such as nutritional supplementation, deworming and vaccination,⁴² reinforcing the hypothesis that health effects on self-reported colds likely resulted from increased contact between children at preschool and not changes in health practices of children and caregivers.

Furthermore, we found no effects of the program on long term indicators of child health as measured by height or weight for the Target Child or younger sibling.⁴³ 32.4% of Target children remained stunted and 9.1% showed signs of wasting at the time of the follow-up survey. Given that children started the preschool program at age 3 or older, well past the critical window of the first 1,000 days for nutrition, and that there was no feeding component of the program, the only plausible mechanism for influencing children’s growth was through parent meetings, where nutrition was one of multiple topics covered in the meetings. However, the absence of effects on

⁴¹ The intervention aimed to strengthen health and nutrition behaviors and practices of caregivers at home through parenting meetings, but no health and nutrition services were provided directly to the children.

⁴² See Supplementary Materials Tables 25 and 26.

⁴³ See Supplemental Materials Tables 27 and 28.

the aggregate health index (Table 9) or on child anthropometrics suggest that the program had negligible health impacts. As such, the effects of the preschool program on child development and schooling outcomes discussed previously are unlikely to be driven indirectly through improved health.

6.4. Parenting

Children spend most of their time with their parents, and parents' behavior is central to child development. Parents not only determine the resources and time to invest in children, but also shape child development through their expression of affection, warmth, sensitivity to children's emotions and engagement into activities that promote child learning. Parenting behavior has been linked to child cognitive and language development (Lugo-Gil and Tamis Le Monda, 2008; Hart and Risley, 1995), and interventions aimed to improve parental engagement in child development have shown positive results in Jamaica (Gertler et al, 2014) and in Colombia (Attanasio et al, 2013).

Through its monthly caregiver meetings, the preschool intervention sought to build positive caregiving practices of parents and primary caregivers that would complement learning activities conducted in preschool. We constructed an index of parenting practices that combines activities in which parents actively interact with their children, such as playing with toys, reading to the child, telling stories, singing songs, playing games or naming objects, among other activities.⁴⁴ For caregivers whose children were enrolled into pre-school, the caregiving index increased by 0.23σ (model 3 of Table 9), suggesting that the program successfully promoted such practices.

6.5. Treatment Heterogeneity

The effects of attending preschool may have varied according to a child's initial level of human capital and the amount of investments made by parents. Given the opportunity to send a child to preschool, parents may have decided to allocate resources among siblings in different ways, depending on their beliefs about the potential returns to preschool, the perceived ability of their children, their preferences, and their capacity to create a rich environment to promote learning and language development. Once a child went to preschools, teachers may have also allocated attention differentially to each child. The overall result on the allocation of human capital among

⁴⁴ See Supplementary Materials Table 14 for the full set of practices.

children of different gender and initial skills depends on the combination of program targeting, parent and teacher investments, and the production function of skill formation.

We analyze treatment heterogeneity on our summary indices of child development, schooling, parenting and health outcomes presented in Table 9, disaggregated by child characteristics and baseline conditions including gender, orphan status, wealth, parenting skills and cognitive development. The first row of table 10 presents the OLS estimates (first stage) of the impact of offering preschool on the probability of enrollment into preschool. We observe significant effects for all sub-groups of children. However, enrollment was substantively larger for girls and children with ex-ante lower probability of enrolling in primary school.⁴⁵

Next, for each subsample, we estimated the effect of preschool attendance on the summary index outcome variables for cognitive development, schooling, parenting and health. Columns 1 and 2 split the sample between boys and girls. Preschool had a large and significant effect on boys of 0.387σ , and a positive but non-significant effect for girls. Thus, while girls were slightly more likely to enroll in preschool in treatment communities, preschool participation appears to have had a larger effect on the development of boys. The effects of preschool on schooling transition was positive and significant for both boys and girls, though also larger for boys. In terms of parenting, despite a clear gender division of labor and potentially different market returns to education, parents did not seem to favor boys over girls,⁴⁶ neither as observed through parenting practices or health outcomes.

Columns 3 and 4 of Table 10 separate the analysis by orphan status, with approximately 10% of our sample orphaned at baseline (primarily single-parent). The likelihood of preschool enrollment was similar for both groups. However, gains in child development and schooling were concentrated among orphans, suggesting that preschool may have helped narrow the gap between orphans and other children in terms of early human capital investments. On the other hand, the parenting index and health indices were larger in the non-orphaned group. Preschool

⁴⁵ To calculate the ex-ante probability of enrolling into primary school, we estimate a Probit model for children in control communities, using information on dwelling conditions, parents' assets, parents' education, child sex, orphan status, age in months, baseline anthropometrics and baseline scores from ASQ and TVIP. We then use the forecast of the probability of being enrolled in primary school, for both children in control and treatment areas, to rank children. We split the sample at the median.

⁴⁶ In India, for example, boys receive more time from their parents on childcare, more vitamin supplementation and are more likely to be breastfed longer than girls (Barcelos et al, 2014).

attendance favored the poorest children (columns 5 and 6) relative to wealthier children on all outcomes except child development, where wealthier children appear to have larger gains.

In columns 7 and 8 of Table 10 we split the sample based on the ex-ante predicted probability of attending primary school.⁴⁷ Children with lower predicted primary school attendance had a higher likelihood of enrolling in preschool. Their child development factor increased by 0.37σ and schooling index increased by 0.62σ , whereas children with a high ex-ante predicted probability of primary school enrollment showed no effects on the child development factor or schooling. This result suggests that the effects of the program were derived primarily from those children who would have otherwise had a lower probability of attending primary school. Figures 7 and 8 show the schooling effects graphically, plotting non-parametric regressions of the actual probability of primary school enrollment (ever enrolled and currently enrolled, respectively) against the predicted probability. The difference between the solid (treatment) and the dashed (control) lines shows the effect of preschool on primary school enrollment for a given level of ex-ante probability of being into primary school. For both figures 7 and 8, the effect of preschool was larger at lower predicted levels of primary school attendance.

In columns 9 and 10 of Table 10 we analyze effects for children above and below the median child development factor at baseline. Results show that cognitive gains from preschool were concentrated among children with above median child development factor at baseline. While both groups have positive coefficients on the schooling index, the result was only significant for the higher child development factor group. Finally, in columns 11 and 12 we observe that the effects of preschool were large and significant for children with parents in the lower half of the distribution in terms of parenting skills. These children experienced gains of 0.53σ in cognitive development and 0.71σ on schooling.

In addition to treatment heterogeneity by child and household characteristics, we explored associations between outcomes and treatment exposure duration, substituting D_{ijt} in equation (2) with the number of months a child attended preschool. Results are shown in the final column of Supplementary Materials Table 28 (available upon demand). We found that time under treatment was positively associated with child development outcomes, with an estimated effect of

⁴⁷ We estimate the probability of attending primary schools for non-contaminated control communities through a probit regression. We then predict the probability of primary school attendance for children in treatment communities.

0.025 standard deviations per additional month of preschool in relation to the Child development factor outcome.

Overall, the heterogeneity analysis suggests that even though the probability of enrollment appears to be similar in most sub-groups, preschool was most effective at promoting development and primary school enrollment for the more vulnerable and disadvantaged children, including orphans, children from less wealthy households, those least likely to otherwise enroll in primary school and children in home environments with lower parenting skills. In the context studied here, preschool helps lower initial inequities in terms of cognition and primary schooling. Furthermore, children with higher baseline cognitive abilities benefited from preschool, suggesting potential dynamic complementarities in human capital investments at an early age.

6.6. Spillover Effects on Siblings and Caregivers

Having discussed the primary impacts on preschool aged children, we now turn to effects of the preschool program on older siblings and caregivers. Having a young child in the household enrolled in preschool may have freed up time for older siblings and caregivers who would otherwise help with childcare. Furthermore, the preschool program may have influenced parents' views on the importance of school, encouraging enrollment of other children in the household. Table 11 presents the estimated impacts of having a preschool aged child enrolled in preschool during the treatment period on the school enrollment status of children 10 to 14 years old in the same households. Children 10 to 14 were too old to enroll in preschool at the start of the program, so any impacts of the program are indirect effects. We observe a 4.9 percentage point increase in the likelihood that an older child was enrolled in school (model 1). The positive spillover on school attendance may be explained, at least in part, by a decrease in the time older children spend taking care of younger siblings (model 2). Older children whose sibling went to preschool spend 1.2 fewer hours per week taking care of children, and spend an additional 2.7 hours on schooling and homework related activities (model 3).

Finally, we explored the effects of preschool on adult labor supply. While there is no effect on aggregate for adult household members⁴⁸, we found a 7.1 percentage point increase in labor supply for the primary caregiver (significant at the 10% level), representing an almost 30%

⁴⁸ See Supplementary Materials Table 23.

increase relative to the control.⁴⁹ These positive spillover effects on older siblings and the primary caregiver suggest that center based models of child development may have the added advantage compared to home based models of freeing up caregiver time, which can be at least partially reallocated to productive activities such as schooling, in the case of older siblings, and work in the case of caregivers.

7. Conclusions

We studied a low-cost community based preschool intervention for children 3 to 5 years old in rural communities in Mozambique. Results from a population based sample of children in treatment and control communities indicate that children who attended preschool improve several important dimensions of child development, including cognitive, communication, fine motor and socio-emotional, and increased primary school enrollment at the appropriate age. Results on a complementary sample of first graders suggested that preschool participation leads to improved school readiness and performance in the first grade. The gains from preschool were largest for the poorest and most vulnerable children and those with higher initial levels of cognitive abilities. These improvements were achieved despite high levels of stunting, wasting and developmental delays, with an intervention that began after the critical developmental period of the first 1,000 days. The center based model with monthly parent meetings also resulted in improved parenting practices, and freed up time for older siblings to attend school and for caregivers to increase labor participation.

While early childhood interventions have been shown to positively affect the development of vulnerable children in developed and middle-income countries, it was not clear whether these effects would translate to extremely poor rural areas of Sub-Saharan Africa. If the productivity of early childhood interventions were complementary to initial levels of child nutrition, health, family resources and parenting quality, then the returns to preschool investments in resource deprived areas might be low. Moreover, in low-density rural areas with few opportunities for secondary education and beyond, identifying qualified teachers to work in preschools could be a major

⁴⁹ We find a positive and significant correlation in control communities between having a caregiver working and child's child development factor in control communities (Supplementary Materials Table 24). We rule out, though, the possibility that our results on child cognitive gains and the impacts on child enrollment in primary school are driven by labor market and income effects. A simple back of the envelope calculation yields an impact of 0.006σ ($=0.037^* 0.183$) on child development factor from changes in labor supply, well below the estimated impact of 0.171σ . The absence of treatment effects on child anthropometrics also helps rule out that our primary effects are driven by an income effect.

constraint. In fact, various studies of preschool interventions in low-income settings have found null or only modest effects on child development (Bouguen et al, 2013; Arbour et al, 2016; Ozler et al, 2016; Behrman, Cheng and Todd, 2004; Rosero and Oosterbeek, 2011), raising questions about the viability and cost-effectiveness of this type of intervention in resource deprived settings.

On the other hand, our costing analysis⁵⁰ yielded an estimated cost of US\$3,09 per student per month, which translated into a 1.14 standard deviation improvement in the ASQ test score per \$100 investment, and places the Mozambique preschool intervention studied here on par with other cost-effective educational interventions for improving learning outcomes in Africa.⁵¹ In addition to child development benefits, we found that the community preschool model increased school enrollment and generated positive spillovers on caregiver abilities, labor supply and older sibling's school enrollment, further increasing the likely benefit-cost ratio.

While encouraging, our results motivate several research extensions for the scale up of low-cost preschool models. First is whether the results of the well implemented program studied here can be reproduced at scale, including for example at a national level by a public agency. This question should be tested using rigorous evaluations of similar interventions at larger scale in Mozambique⁵² and in other countries and contexts. Second, enrollment in the preschool model studied here was demand driven, with just over half of eligible children enrolling in treatment communities. Since children who voluntarily enroll in preschool differ from those who do not, the effects of extending preschool coverage to achieve higher (or even universal) coverage in such contexts remains an open question. As documented in the paper, several demand-side constraints prevented children from participating in the preschool program even when these were available in their communities. Further research will be needed to better understand how to alleviate these constraints to ensure that all targeted children, especially the most vulnerable, can benefit. Finally, the long run effects of a preschool based child development model in a low-income setting remain largely an open question, as preschoolers' long run educational and

⁵⁰ See Supplemental Materials section 8.

⁵¹ See Supplementary Materials Table 38 and <https://www.povertyactionlab.org/policy-lessons/education/increasing-test-score-performance> (accessed July 29, 2017).

⁵² Follow-up data were collected on this sample of children in 2014, while children were between the ages of 9 and 11 years, and further longitudinal data could be collected subsequently to address this question in the Mozambican context. A separate ongoing study aims to do precisely that by assessing the impact of a national program currently being rolled out by the government across five provinces.

economic outcomes may be conditioned on access to and quality of the educational systems available locally for primary school and beyond.

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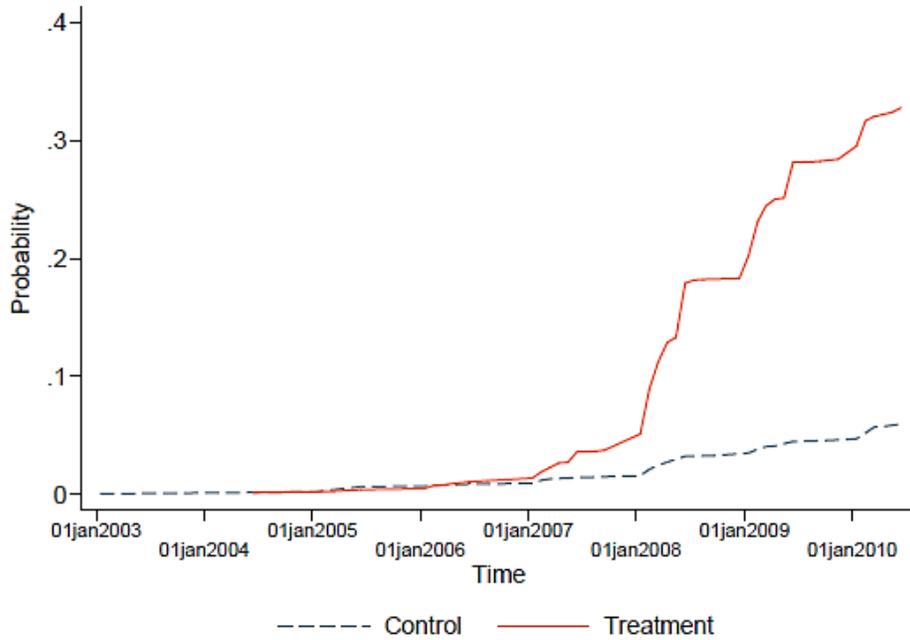
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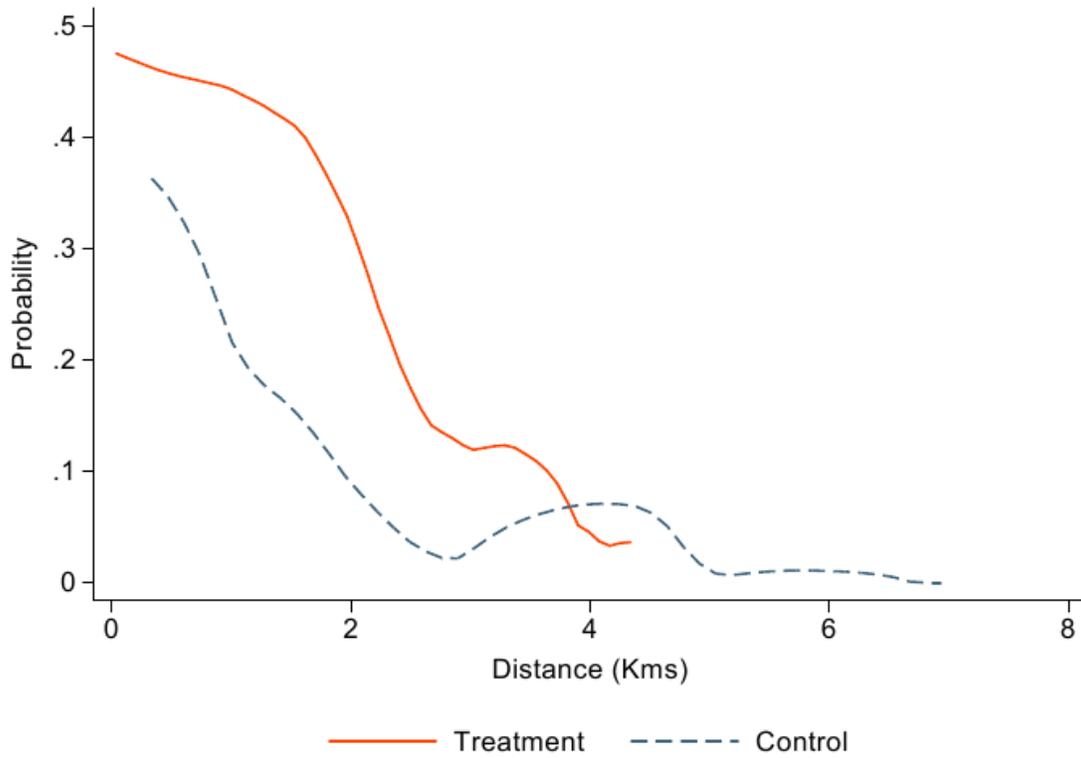
FIGURES

Figure 1: Preschool Enrollment (children ages 3-9) in treatment and control communities



Notes: This figure presents the probability of preschool enrollment by month, from January 2003 until June 2010, for children ages 3-9 in treatment and control communities. Lines represent the cumulated proportion of children who ever attended preschool based on the primary caregivers' report of the month and year the child started attending preschool.

Figure 2: Preschool Enrollment by distance to the nearest preschool



Notes: Figure 2 shows the proportion of children aged 3 to 9 in 2010 who enrolled preschool, by distance to the nearest preschool operated by Save the Children.

Figure 3: TVIP- Raw score

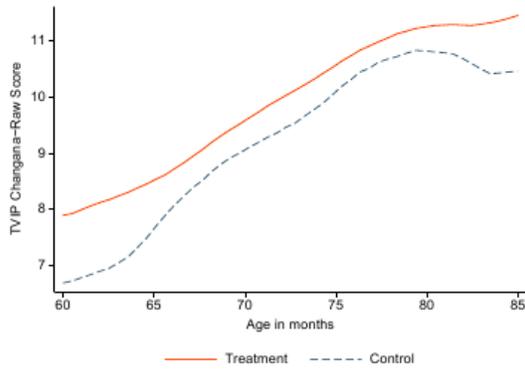


Figure 4: TVIP- Standardized score
(By developers' manual)

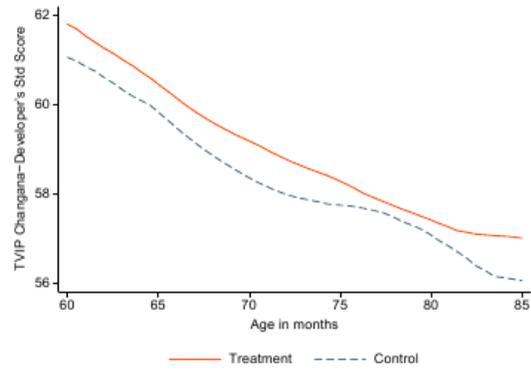


Figure 5: TVIP- Probability of censoring

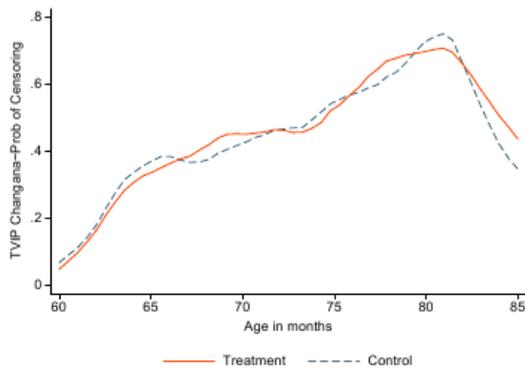
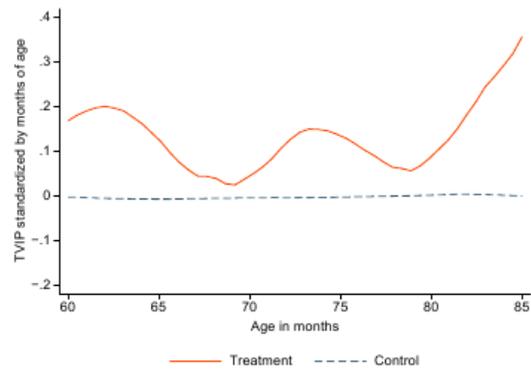
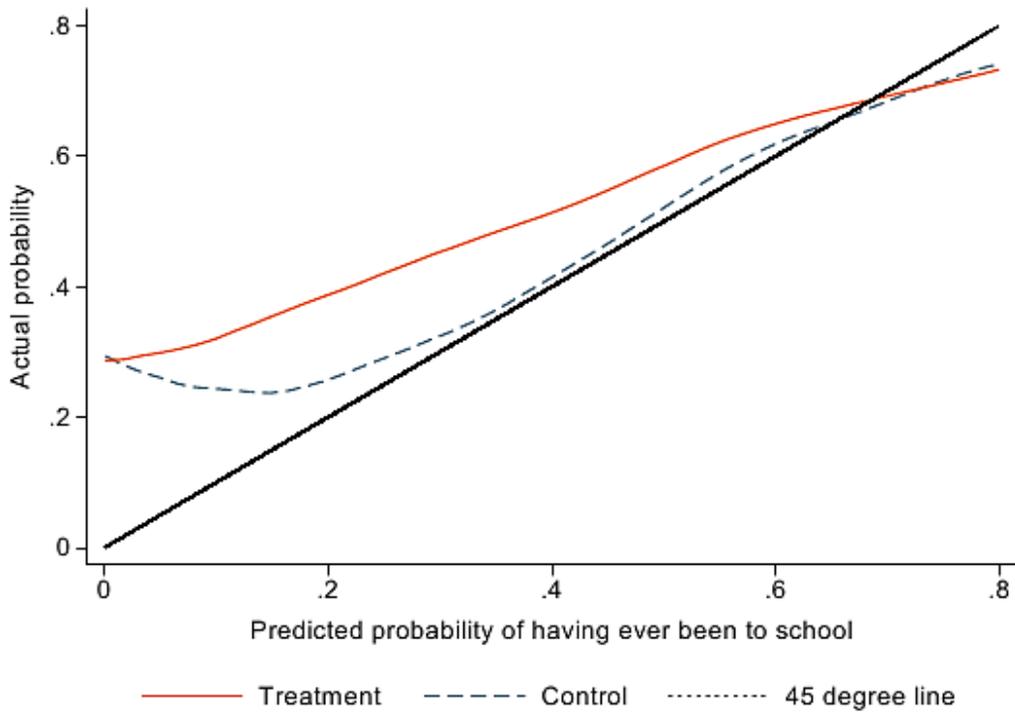


Figure 6: TVIP- Standardized score
(Relative to control mean for each month of age)



Notes: Figures (3), (4) and (6) show non-parametric regressions of TVIP scores on age in months, by treatment and control communities. Figure (5) shows a non-parametric regression of the probability of censoring on age in months. In figure (4), the score is normalized according to the test developers' standard. In figure (6), we calculate the within sample standardized score by subtracting the control mean and dividing by control standard deviation, for each age in months.

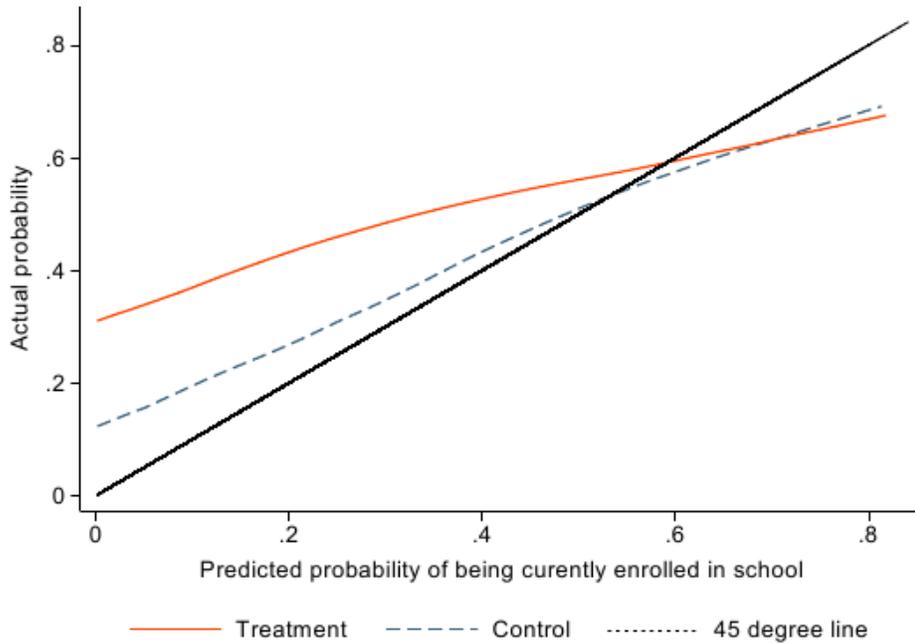
Figure 7: Actual X predicted probability of having ever been to primary school



Notes: Figure 7 shows a non-parametric regression of the actual probability of having ever been to primary school against the predicted probability of having ever been to primary school, for all children aged 5 to 9 at endline.

Figure 8- Heterogeneous impact on probability of enrolling into primary school

Figure 8: Actual X predicted probability of being currently enrolled into primary school



Notes: Figure 8 shows a non-parametric regression of the actual probability of being currently enrolled into primary school against the predicted probability of being enrolled into primary school, for all children aged 5 to 9 at endline.

TABLES

TABLE 1
PRESCHOOL CHARACTERISTICS

Teacher characteristics (N=98)	
Female	93.22%
Age	33
Years of Education	6.16
Married or partnered	70.69%
Household size	5.98
Number of own children	3.05
Own child attends preschool	54.39%
Hours spent at preschool per day	3.46
Hours spent on training, meetings and other preschool related activities per month	3.64

Checklist for items present at the classroom in the last 30 days (N=57)	
Blackboard	96.55%
Chalk	91.38%
Notebooks or sheets to write on	89.66%
Pencils and pens	93.10%
Picture books	86.21%
Picture cards	89.66%
Cards games	75.86%
Construction blocks	93.10%
Dolls/puppets	79.31%
Other toys	91.38%
Attendance lists	93.10%
Chairs	29.31%
Mats	72.41%

Checklist for items present at the preschool in the last 30 days (N=27)	
Running water	39.66%
Soap	72.41%
Swing	87.93%
Kids climber	79.31%
Seesaw	68.97%

TABLE 2
BASELINE BALANCE

	Treatment mean N=1028	Control mean N=879	Means difference	T-stat
<i>Household characteristics</i>				
Number of household members	5.102	4.945	0.157	0.974
Asset index	-0.208	0.103	-0.311	-1.045
Number of rooms at home	2.085	2.239	-0.154	-1.578
Improved latrine at home	0.155	0.118	0.037	1.657
Adobe walls at home	0.660	0.673	-0.013	-0.348
Dirty floor at home	0.803	0.839	-0.036	-1.267
<i>Target child characteristics</i>				
Female	0.511	0.500	0.011	0.517
Age (years)	3.462	3.486	-0.024	-0.888
Speaks Portuguese	0.132	0.122	0.010	0.321
Orphaned	0.103	0.099	0.004	0.206
ASQ Total Score	199.829	197.861	1.968	0.617
TVIP raw score	5.827	5.566	0.261	0.803
TVIP score-within sample standardized score	0.083	0.104	-0.020	-0.129
TVIP score-standardized by developers table	78.852	78.519	0.333	0.550
Child had skin problems in the last 4 weeks	0.158	0.105	0.053	0.812
Child had swallowing difficulties in the last 4 weeks	0.037	0.031	0.006	0.483
Respiratory illness (flu, pneumonia, asthma) in the last 4 weeks	0.139	0.108	0.031	1.317
Child had diarrhea in the last 4 weeks	0.062	0.034	0.028	2.691
Child slept in mosquito net the night before	0.146	0.102	0.044	1.465
Child has been dewormed in the last 12 months	0.114	0.099	0.015	0.839
Child received vitamin A (Health card)	0.424	0.404	0.021	0.621
Child was diagnosed with malaria in the last 4 weeks	0.074	0.060	0.014	1.182
Weight for age z-score	-0.327	-0.260	-0.067	-0.802
Height for age z-score	-1.552	-1.515	-0.037	-0.365
Weight for height Z-score	1.271	1.239	0.032	0.233
<i>Caregiver characteristics</i>				
Age (years)	35.993	36.319	-0.326	-0.319
Female	0.859	0.821	0.039	1.089
Speaks Portuguese	0.488	0.490	-0.002	-0.040
Read and write	0.611	0.632	-0.021	-0.547
Years of education	3.239	3.410	-0.171	-0.686
Married or partnered	0.661	0.692	-0.031	-0.963
Reads/skims through books with child	0.533	0.527	0.006	0.132
Plays with child in the garden	0.457	0.415	0.042	1.099
Spends time naming and drawing objects with child	0.408	0.374	0.034	0.789
Plays games with child	0.423	0.474	-0.051	-1.154
Practices self-sufficiency activities with child	0.583	0.576	0.007	0.210

Notes: T-stats computed through simple linear regression with standard errors clustered at community level. Asset index calculated by principal components using a list of household assets. Dirty floor includes mud, sand, and adobe. Within sample standardized TVIP score calculating by subtracting the age in months controls average and dividing the age in months standard deviation.

TABLE 3
CHILD DEVELOPMENT-AGES AND STAGES QUESTIONNAIRE

Dep var:	Total ASQ Score (1)	Communication (2)	Problem Solving (3)	Precise Motor Coordination (4)	Gross Motor Coordination (5)
OLS: Treatment community	0.184*** (0.043)	0.174*** (0.054)	0.166*** (0.037)	0.152*** (0.044)	0.080 (0.054)
IV: Ever been to preschool	0.370*** (0.096)	0.350*** (0.116)	0.334*** (0.078)	0.307*** (0.098)	0.161 (0.111)
Observations	1,831	1,831	1,831	1,831	1,831
Control Mean:	0.000	0.000	0.000	0.000	0.000
Control Standard Deviation:	1.000	1.000	1.000	1.000	1.000
Control Complier Mean:	-0.257	-0.285	-0.212	-0.189	-0.140

Notes: Analysis sample includes target children. The first line reports the estimates of an OLS regression of each section of the Ages and Stages Questionnaire on a dummy that indicates the treatment status of the community. The second line reports IV estimates of the effect of preschool attendance. Preschool attendance is instrumented by the community treatment status. Each variable was standardized by subtracting the mean at control communities and by dividing by the standard error. Control complier mean calculated as in Katz et al (2001). Total ASQ score is the sum of all 4 sub-section scores. All regressions include dummies for randomization blocks, local district and local administrative post, and presence of non-Save the Children preschools in the community. Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in months, sex, height for age at baseline, weight for age at baseline, parents speak Portuguese at baseline, mother deceased at baseline, father deceased at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, stunted at baseline, child with risks of communication deficits at baseline, child with risks of motor coordination deficits at baseline, child with risks of precise motor coordination at baseline, child with risks of problem resolution deficits at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, and household age equivalent size.

TABLE 4
RECEPTIVE VOCABULARY TEST (TESTE DE VOCABULARIO POR IMAGENS PEABODY-TVIP)

Dep var:	Raw Score (1)	Within-sample Standardized Score (2)	Standardized Score- By Developers table (3)	Probability of Censoring (4)	Standardized Score- By Developers table (Uncensored Sub-sample) (5)
OLS: Treatment community	0.664 (0.429)	0.130** (0.063)	0.910* (0.456)	0.001 (0.022)	1.716** (0.742)
IV: Ever been to preschool	1.313 (0.831)	0.258** (0.123)	1.800** (0.862)	0.001 (0.044)	3.184** (1.312)
Censored Observations	x	X	x	x	
Observations	1,801	1,801	1,801	1,801	925
Control Mean:	8.962	0.000	59.249	0.472	63.045
Control Standard Deviation:	6.739	0.983	6.942	0.500	7.794
Control Complier Mean:	8.634	-0.135	57.936	0.452	60.484

Notes: Analysis sample includes target children. The first line reports the estimates of an OLS regression of each section of the Teste de Vocabulario por Imagens Peabody (TVIP) on a dummy that indicates the treatment status of the community. The second line reports IV estimates of the effect of preschool attendance. Preschool attendance is instrumented by the community treatment status. The raw score is calculated by taking the number of questions answered by child and subtracting the number of wrong answers. The within sample standardized score is calculated by subtracting the average of raw score and dividing by the standard deviation for each month of child age, as in Schady et al (2014). The standardized score according to developers table reflects the relative position of the child from a sample of Mexican and Puerto Rican children. Per those norms, the average is 100 and one standard deviation is 15, for all ages. For each age, there is a minimum score that can be normed, and last column only contains observations that are higher than the minimum score. Control complier mean calculated as in Katz et al (2001). All regressions include dummies for randomization blocks, local district and local administrative post, and presence of non-Save the Children preschools in the community. Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in months, sex, height for age at baseline, weight for age at baseline, parents speak Portuguese at baseline, mother deceased at baseline, father deceased at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, stunted at baseline, child with risks of communication deficits at baseline, child with risks of motor coordination deficits at baseline, child with risks of precise motor coordination at baseline, child with risks of problem resolution deficits at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, and household age equivalent size.

TABLE 5
EARLY DEVELOPMENT INDEX- FIRST GRADERS

Dep var:	Physical Health and Well-being (1)	Communication and General Knowledge (2)	Cognitive Development and Language (3)	Social Competence (4)	Emotional Maturity (5)
OLS: Treatment community	0.301* (0.154)	0.373** (0.153)	0.429*** (0.148)	0.329 (0.233)	0.300 (0.222)
Observations	919	919	919	919	919
Control Mean:	-0.054	-0.030	-0.094	-0.070	-0.057
Control Standard Deviation:	0.986	1.013	1.051	1.031	0.890

Notes: Sample consists of a random sample of first graders in primary schools of treatment and control communities. Each domain is standardized with mean zero and standard deviation equal to one. The first line reports the estimates of an OLS regression of each development domain on the dummy that indicates that a preschool was built at the community where the primary school is located. All regressions include dummies for randomization blocks, local district and local administrative post. Standard errors clustered at class level. Controls include child age in years, sex, time elapsed since the start of school year and the date of the interview, flag for date of start of classes not reported, date of interview, number of students at class, teacher's sex, teacher's highest grade completed, and teacher's subjective familiarity with students.

TABLE 6
PRIMARY SCHOOL ENROLLMENT -CHILDREN AGED 5 TO 9

Dep var:	Currently Enrolled at School (1)	Ever gone to School (2)	Appropriate Grade for Age (3)	Dropout from School (4)
OLS: Treatment community	0.082*** (0.023)	0.070*** (0.022)	0.056*** (0.019)	-0.007 (0.009)
IV:Ever been to preschool	0.212*** (0.061)	0.182*** (0.056)	0.149*** (0.050)	-0.020 (0.027)
Observations	2,591	2,686	2,891	1,872
Control Mean:	0.635	0.676	0.474	0.040
Control Standard Deviation:	0.482	0.468	0.499	0.196
Control Complier Mean:	0.414	0.487	0.336	0.059

Notes: Sample includes all children aged 5 to 9 at endline. The first line reports the estimates of an OLS regression of each outcome on a dummy that indicates the treatment status of the community. The second line reports IV estimates of the effect of preschool attendance. Preschool attendance is instrumented by the community treatment status. All regressions include dummies for randomization blocks, local district and local administrative post, and non-Save the Children preschools. Control complier mean calculated as in Katz et al (2001). Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in years, sex, parents speak Portuguese at baseline, mother deceased at baseline, father deceased at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, and household age equivalent size.

TABLE 7
HOURS ON ACTIVITY DURING LAST WEEK -CHILDREN AGES 5 TO 9

Dep var:	School and Homework (1)	Play (2)	Work at Family's Plot (3)	Household Chores (4)	Caring for children elders and sick (5)	Community Meetings (6)	Sleep (7)	Other Activities (8)
OLS: Treatment community	2.214*** (0.817)	0.468 (0.898)	-0.381 (0.248)	-0.078 (0.136)	-0.034 (0.126)	-0.312 (0.225)	0.110 (0.814)	-1.986 (1.610)
IV: Ever been to preschool	5.869*** (2.189)	1.240 (2.395)	-1.011 (0.645)	-0.207 (0.362)	-0.091 (0.334)	-0.827 (0.619)	0.290 (2.149)	-5.263 (4.219)
Observations	2,891	2,891	2,891	2,891	2,891	2,891	2,891	2,891
Control Mean:	15.708	21.819	2.597	0.749	0.567	1.054	61.407	64.100
Control Standard Deviation:	15.120	15.797	6.681	3.358	2.385	5.371	16.861	32.204
Control Complier Mean:	12.739	21.277	2.284	0.712	0.590	1.640	62.955	65.804

Notes: Sample includes all children ages 5 to 9 at endline. The first line reports the estimates of an OLS regression of each outcome on a dummy that indicates the treatment status of the community. The second line reports IV estimates of the effect of preschool attendance. Time on each activity is measured in hours per week. All regressions include dummies for randomization blocks, local district and local administrative post, and non-Save the Children preschools. Control complier mean calculated as in Katz et al (2001). Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in years, sex, parents speak Portuguese at baseline, mother deceased at baseline, father deceased at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, household age equivalent size.

TABLE 8
HEALTH OUTCOMES OF TARGET CHILDREN

	Child was sick in the last four weeks (1)	Child had skin problems in the last four weeks (2)	Child had Diarrhea in the last four weeks (3)	Child had cough in the last four weeks (4)	Child had fever in the last four weeks (5)	Child had breathing problems in the last four weeks (6)	Child was diagnosed with malaria in the last four weeks (7)	Child had swallowing difficulties in the last four weeks (8)
OLS: Treatment community	0.072** (0.030)	-0.023 (0.020)	-0.015 (0.012)	0.077** (0.038)	0.028 (0.021)	-0.038 (0.038)	-0.009 (0.017)	0.009 (0.009)
IV: Ever been to preschool	0.145** (0.065)	-0.047 (0.040)	-0.031 (0.023)	0.155* (0.082)	0.056 (0.043)	-0.068 (0.068)	-0.018 (0.034)	0.018 (0.018)
Observations	1,836	1,837	1,832	1,839	1,833	829	1,828	1,829
Control Mean:	0.365	0.146	0.080	0.443	0.283	0.388	0.169	0.040
Control Standard Deviation:	0.482	0.353	0.271	0.497	0.451	0.488	0.375	0.196
Control Complier Mean:	0.291	0.178	0.086	0.351	0.242	0.390	0.182	0.024

Notes: Analysis sample includes target children. The first line reports the estimates of an OLS regression of each outcome on a dummy that indicates the treatment status of the community. The second line reports IV estimates of the effect of preschool attendance. All health outcomes reported by caregiver. Control complier mean calculated as in Katz et al (2001). All regressions include dummies for randomization blocks, local district and local administrative post, and non-Save the Children preschools. Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in months, sex, height for age at baseline, weight for age at baseline, parents speak Portuguese at baseline, mother deceased at baseline, father deceased at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, stunted at baseline, child with risks of communication deficits at baseline, child with risks of motor coordination deficits at baseline, child with risks of precise motor coordination at baseline, child with risks of problem resolution deficits at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, and household age equivalent size.

TABLE 9
SUMMARY INDECES

Dep var:	Cognitive Index (1)	Schooling index (2)	Parenting index (3)	Health index (4)
OLS: Treatment community	0.171*** (0.050)	0.136*** (0.044)	0.119** (0.052)	0.064 (0.062)
IV:Ever been to preschool	0.337*** (0.107)	0.360*** (0.117)	0.232** (0.104)	0.126 (0.125)
Observations	1,686	2,891	1,630	1,697
Control Mean:	0.075	-0.039	-0.011	-0.002
Control Standard Deviation:	0.956	1.010	0.994	1.017
Control Complier Mean:	-0.183	-0.402	-0.141	-0.099

Notes: Sample includes target children for analysis in models (1), (3) and (4). Sample in model (2) includes all children ages 5 to 9 at endline. See Supplementary Materials Section 4 for the construction of each index. All regressions include dummies for randomization blocks, local district and local administrative post, and non-Save the Children preschools. Control complier mean calculated as in Katz et al (2001). Estimates weighted by community population size. Standard errors clustered at community level. Controls for model (2) include child age in years, sex, parents speak Portuguese at baseline, mother deceased at baseline, father deceased at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, household age equivalent size. Models (1), (3) and (4), additionally control for height for age at baseline, weight for age at baseline, dummy for being under median of asset index at baseline, stunted at baseline, child with risks of communication deficits at baseline, child with risks of motor coordination deficits at baseline, child with risks of precise motor coordination at baseline and dummy for child with risks of problem resolution deficits at baseline.

TABLE 10
SCHOOLING OUTCOMES OF OLDER SIBLINGS AGED 10 TO 14

Dep var:	Currently enrolled at school (1)	Ever gone to school (2)	Appropriate grade for age (3)	Dropout from school (4)	Time taking care of children (5)	School and Homework (6)
OLS: Treatment community	0.020 (0.015)	0.028** (0.012)	0.002 (0.035)	0.013 (0.012)	-0.659** (0.252)	1.477* (0.809)
IV: A younger sibling has been to preschool	0.034 (0.027)	0.049** (0.023)	0.003 (0.060)	0.022 (0.021)	-1.205** (0.458)	2.703* (1.537)
Observations	1,575	1,660	1,372	1,544	2,035	2,035
Control Mean:	0.867	0.926	0.484	0.054	2.075	2.075
Control Standard Deviation:	0.340	0.262	0.500	0.227	4.735	4.735
Control Complier Mean:	0.849	0.892	0.492	0.033	3.237	-0.671

Notes: This table reports estimates of the effects of the provision of preschool centers at community and the estimates of spillover effects of preschool attendance of a younger sibling. Sample includes only siblings of target children who are aged 10 to 14 at endline and who had not been enrolled at preschool. The first line reports the estimates of an OLS regression of each outcome on the dummy that indicates the treatment status of the community. The second line reports IV estimates of the effect of having a younger sibling who went to preschool. The endogenous variable is a dummy that is equal to one if any younger household member has been to preschool. Instrument is the community treatment status. See table 10 for estimates of the impact of preschool on schooling outcomes of the sample of children aged 5 to 9 at endline. Time taking care of children measured in hours per week. See table 11 for estimates of preschool impact of preschool on time use of children aged 5 to 9. All regressions include dummies of randomization blocks, local district and local administrative post, as well the presence of other than Save the Children preschools at the community. Control complier mean calculated as in Katz et al (2001). Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in years, sex, parents speak Portuguese at baseline, mother dead at baseline, father dead at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, orphan at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, household age equivalent size.

TABLE 10
HETEROGENEOUS EFFECTS BY SUBGROUPS OF CHILDREN

Groups:	Boys	Girls	Non-orphans	Orphans	Under median asset Index	Above Median asset Index	Low prob prim school	High prob prim school	Under median cognitive factor	Above median cognitive factor	Under median parent Index	Above median parent Index
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep var: OLS: Child ever been to preschool	0.349*** (0.026)	0.401*** (0.028)	0.372*** (0.038)	0.378*** (0.026)	0.384*** (0.023)	0.368*** (0.035)	0.461*** (0.038)	0.287*** (0.023)	0.369*** (0.076)	0.378*** (0.025)	0.352*** (0.032)	0.388*** (0.028)
IV: Schooling index	0.431** (0.191)	0.334*** (0.113)	0.333 (0.316)	0.381*** (0.109)	0.445*** (0.165)	0.245 (0.194)	0.625*** (0.131)	-0.099 (0.147)	0.499 (0.578)	0.319*** (0.120)	0.714*** (0.177)	0.138 (0.173)
IV: Child development factor	0.387*** (0.130)	0.249 (0.154)	0.053 (0.285)	0.426*** (0.125)	0.322*** (0.117)	0.417*** (0.159)	0.376*** (0.101)	-0.045 (1.007)	-0.768 (0.613)	0.418*** (0.102)	0.536*** (0.208)	0.218** (0.096)
IV: Parenting index	0.302** (0.143)	0.324** (0.148)	0.815** (0.392)	0.232* (0.129)	0.299** (0.146)	0.268 (0.200)	0.233* (0.125)	0.365* (0.197)	-0.192 (0.453)	0.324*** (0.118)	0.345 (0.276)	0.225* (0.120)
IV: Health index	-0.211 (0.209)	0.106 (0.185)	0.613** (0.302)	-0.142 (0.172)	0.021 (0.197)	-0.148 (0.215)	-0.111 (0.168)	0.117 (0.240)	0.247 (0.641)	-0.071 (0.160)	-0.186 (0.223)	0.001 (0.211)

Notes: The first row presents estimates of an OLS regression of the probability of preschool enrollment. IV regressions show the estimates of an instrumental variables regression of each outcome on the dummy indicating preschool enrollment. All children aged 5 to 9 are included in columns (1), (2), (3), (4), (5), (6), (7), (8), (11), (12) in the OLS Child ever been to preschool and Schooling index regressions. Columns (9) and (10), and Child development factor, Parenting index and Health index contain only target children. See Supplementary Materials for construction of the indices and factors used in this table. Columns (1) and (2) split the sample between boys and girls. Columns (3) and (4) splits the sample between orphaned (father or mother deceased, or both) and non-orphaned children. Columns (5) and (6) splits the sample by wealth. Column (5) contains only children who are under the median of the asset index. Columns (7) and (8) split the sample by the predicted probability of enrolling in primary school which is estimated using a probit model for having ever been to primary school on a set of covariates for children in control communities. The model is then used to extrapolate the probability to children in treatment communities. Median probability is 0.76. Columns (9) and (10) split the sample by child development factor. Columns (11) and (12) split the sample by the parenting index. All regressions include dummies of randomization blocks, local district and local administrative post, as well the presence of other than Save the Children preschools in the community. Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in years, sex, parents speak Portuguese at baseline, mother dead at baseline, father dead at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, orphan at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, and household age equivalent size.

TABLE 11
SPILLOVERS: SCHOOLING AND LABOR SUPPLY OF OTHER HOUSEHOLD MEMBERS

Dep var:	10-14 Year Old Children			Caregiver
	Ever gone to school (1)	Time taking care of children (2)	Time on School and Homework (3)	Worked in last 30 days (4)
OLS: Treatment community	0.028** (0.012)	-0.659** (0.252)	1.477* (0.809)	0.037* (0.021)
IV: Younger household member has been to preschool	0.049** (0.023)	-1.205** (0.458)	2.703* (1.537)	0.071* (0.040)
Observations	1,660	2,035	2,035	1,726
Control Mean:	0.926	2.075	2.075	0.240
Control Standard Deviation:	0.262	4.735	4.735	0.428
Control Complier Mean:	0.892	3.237	-0.671	0.184

Notes: Sample for models (1)-(3) includes siblings of target children who are aged 10 to 14 at endline and were too old to have been enrolled in preschool. Model (4) includes primary caregivers. The first line reports the estimates of an OLS regression of each outcome on the dummy that indicates the treatment status of the community. The second line reports IV estimates of the effect of having a younger sibling who went to preschool. The endogenous variable is a dummy that is equal to one if any younger household member has been to preschool. Instrument is the community treatment status. Time in models (2) and (3) measured in hours per week. All regressions include dummies for randomization blocks, local district and local administrative post, and non-Save the Children preschools. Control complier mean calculated as in Katz et al (2001). Estimates weighted by community population size. Standard errors clustered at community level. Controls include child age in years, sex, parents speak Portuguese at baseline, mother deceased at baseline, father deceased at baseline, mother's education, father's education, mother's age, father's age, dummy for being under median of asset index at baseline, number of male household members under 1, 2, 3, 4 and 5 years old, number of female household members under 1, 2, 3, 4 and 5 years old, and household age equivalent size.