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The impact of vouchers on preschool attendance and elementary school readiness: A randomized controlled trial in rural China

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ABSTRACT

Although preschool has been shown to improve children's school readiness in many developing countries, preschool attendance in poor rural areas of China is still low. The high cost of preschool is often regarded as a major barrier to attendance. In this paper, we evaluate the impact of a one-year voucher/CCT intervention on preschool attendance and school readiness. To do so, we conducted a randomized controlled trial among 150 young children in a poor, rural county in China. Our analysis shows that the intervention, consisting of a tuition waiver and a cash transfer conditional on attendance, raised attendance by 20 percentage points (or by 35%). However, the intervention did not have measurable impact on children's school readiness. We believe that poor quality of preschool education in rural China (in terms of both teaching and facilities) contributes to our findings.

1. Introduction

Preschool education has been shown to produce many short- and long-term benefits among young children in developed counties. Preschool education (or other types of early childhood education enrolling children aged 6 years old or below) raises the academic and cognitive test scores of young children and reduces their chance of grade repetition during elementary school (Burger, 2010; Currie & Thomas, 1995; Howes et al., 2008; Montie, Xiang, & Schweinhart, 2006; Schweinhart, 2007). Children who attend preschool also demonstrate better skills and achievements during high school and college, get higher earnings, and commit fewer crimes (Barnett & Masse, 2007; Bartik, Gormley, & Adelstein, 2012; Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001; Currie & Neidell, 2007; Currie, 2001; Garces, Thomas, & Currie, 2002). Given these documented benefits, many educators and policymakers in developed countries advocate that young children should attend preschool (Bowman, Donovan, & Burns, 2001; Heckman, 2000; OECD, 2006; Temple & Reynolds, 2007).

In fact, the benefits of preschool education can also be found outside of developed countries. In several recent studies conducted in a number of different developing countries, preschool education is also shown to bring various types of benefits to young children (Aboud & Hossain, 2011; Aboud, 2006; Aguilar & Tansini, 2012; Baker-Henningham & Boo, 2010; Berlinski, Galiani, & Gertler, 2009; Hazarika & Viren, 2013; Martinez, Naudeau, & Pereira, 2012). As such, the agenda of promoting preschool education among developing countries is also

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gaining momentum (Lancet, 2007/2011; Nonoyama-Tarumi & Ota, 2010; Nores & Barnett, 2010; UNESCO, 2010).

In developing countries one major challenge in promoting preschool education is addressing huge gaps in attendance among different population groups. China is a notable example. While almost all children of urban residents attend preschool (Sun, 2008), preschool attendance rates in rural areas are still at around 50% only (Luo et al., 2012; Rao, Sun, Zhou, & Zhang, 2012). In some poorer parts of rural areas the rate has been reported to be as low as 20% (Luo et al., 2012). If preschool education indeed benefits children in both short and long terms, such a huge gap in preschool attendance among different population groups will very likely lead to heightened social and economic inequalities in the future.

Seeking to narrow the preschool attendance gap, China's central government has recently launched a new effort to invest in preschool education in rural areas (State Council, 2010). In 2010, a policy directive, along with financial resources, was issued to all regional and local bureaus of education urging them to increase public spending on preschool education. The directive, however, did not prescribe a specific, definitive set of policy recommendations. Policymakers at regional and local levels were encouraged to find their own ways to best use these funds from the center (State Council, 2010).

In fact, it is important to note that preschool education in China has almost always been privately funded and operated (Luo et al., 2012). Parents have to pay the full cost of tuition and other fees in order to send their children to preschool; however, the level of financial burden is often high. Parents with low incomes may find preschool too expensive to afford. They may opt to keep their children at home instead. If so, providing poor families with financial incentives to attend preschool, such as vouchers that cover preschool tuition or conditional cash transfers (CCT) that pay for other school fees or both of them in a bundle, may increase preschool attendance.

Unfortunately, up-to-date there is little evidence to assess whether providing financial incentives can effectively raise preschool attendance in rural China. There are studies that describe the status of preschool education in both rural and urban areas of China (Bi, Zhang, & Ren, 2007; Liang, 2001; Rao et al., 2012; Wang, 2003; Xie & Young, 1999; Yu, 2005; Zeng, Zhu, & Chen, 2007). These studies, in general, suggest that high cost of preschool is an obstacle to attendance, especially in poor parts of rural China. However, none of these studies are able to definitively identify the determinants of preschool attendance in a cause–effect manner.

Moreover, even if providing financial incentives is effective in increasing attendance, to our knowledge there is no rigorous evaluation of whether children in rural China actually benefit from attending preschool. That is, children who attend preschool may not necessarily show improvements in the skills and *elementary school readiness* (or simply *school readiness* – described in the next section) that they need to thrive in China's competitive public school system. It is also uncertain whether simply raising preschool attendance in rural China will yield positive benefits similar to those found in some other developing countries.

In this study our overall goal is to examine whether a two-part, one-year *voucher/CCT intervention* will increase preschool attendance and school readiness of young children in a poor part of rural China. In the first part of our intervention, parents no longer have to pay preschool tuition for one school year and are allowed to send their children to a preschool of their choice. In the second part, parents are given cash transfer conditional on the preschool attendance of their children during the school year. The intervention as a whole aims at encouraging preschool attendance by helping parents defray the cost of preschool and, as such, increasing the net benefits of sending children to preschool.

To meet the overall goal of this study we pursue three specific objectives. First, we describe the current state of school readiness among young children in a poor county in rural China. Second, we explore the effects of our voucher/CCT intervention (discussed more in the next section) on preschool attendance and school readiness. We also estimate the impact of preschool attendance on children's school readiness using an instrumental variable approach. Third, we seek to explain our findings.

We implemented the voucher/CCT intervention as part of a randomized controlled trial (RCT – randomized at the individual level) in Lushan county of China's Henan Province. The RCT included three stages. In the first stage (July 2008) we conducted a baseline survey to collect information (including measuring school readiness) on a random sample of 141 four-year-old children, none of whom were then attending preschool. In the second stage (the school year from September 2008 to June 2009) we randomly assigned half of the sample children to an intervention group to receive voucher/CCT (henceforth, the *voucher/CCT group*) and kept the other half of the sample children untreated (henceforth, the *control group*). We also collected information on children's attendance during the school year. In the third stage (when the children were just entering grade 1 in September 2010) we conducted an endline test to assess the school readiness of all sample children once again.

The rest of this paper is organized as follows. Section 2 explains our methodology, which includes a discussion of the sampling, intervention/experimental arms, data collection and statistical approach. Section 3 reports the empirical results of the effects of the voucher/CCT intervention on both preschool attendance and school readiness. We also examine whether preschool attendance actually raises school readiness. Section 4, the final section, discusses the results and concludes.

2. Methodology

The study reported in this paper was conducted in Lushan county of China's Henan Province. The county was poor and predominately rural. At the time of our survey almost 80% of the land in the county and 90% of the county population were counted as rural.[1] In 2007, its annual rural

[1] Lushan county is one of six counties randomly selected to be part of a larger survey conducted by the authors in 2008 about preschool education in rural China. The results of the descriptive survey were reported in Luo et al. (2012). The voucher/CCT intervention, however, was later carried out only in Lushan county.

per capita income was only 2050 yuan (about 275 dollars when using the nominal exchange rate; or about 500 dollars when using the purchasing power parity conversion factor from the World Bank – World Bank, 2012). Its annual rural per capita income was ranked in the lowest decile among all of China's counties. As such, the county was designated by the central government as a poor county.

2.1. Sampling method

The first step of the sampling was to create a list of children who were born in rural villages of the study county and were 4 years old at the time of the baseline survey.[2] In order to create this list, we conducted a pre-baseline, canvass survey in June 2008 and obtained from each of the 20 townships in the county two comprehensive listings of children – one from the township health center and another from the township police station. From these listings, we created a *full list* of all children who were born in the county and were 4 years old at the time of the baseline (there were slightly over 10,000 of them).

In order to examine the effects of a voucher/CCT intervention on preschool attendance and school readiness, we further applied two selection criteria to the full list of children obtained from the steps above. First, we excluded children living outside of the county.[3] We applied this criterion using information provided by village leaders in each of the villages within the county. Second, we excluded children who were already attending preschool. We determined the preschool attendance of our sample children using information provided by three different sources – the county bureau of education, the principal of each of the preschools within the county and (again) all the village leaders within the county. Following these steps, we obtained a *shortlist* of 4-year-old children who were born in the county, living in the county and not attending preschool at the time of the canvass survey.[4] From this shortlist of children (there were over 5000 children in the shortlist), we randomly chose 150 of them to participate in our study and make up the sample in this paper.[5]

The next step of the sampling procedure was to administer a baseline survey (including the school readiness test) to all children in the study sample. The research team was then to assign *randomly* the 150 sample children to one of the two experimental arms of the RCT (that is, either the voucher/CCT group or the control group). As it turned out, only 141 of the 150 children in our initial sample completed the baseline school readiness test. The 9 children who dropped out before or during the baseline test did so voluntarily (that is, their parents refused to come to the survey or the children refused to participate). We then randomly assigned the 141 children to the two experimental arms. Specifically, we randomly allocated 70 children to the voucher/CCT group and the other 71 children to the control group.

Due to various reasons (e.g., relocation with parents to the city), there was attrition at the end of the two-year study. During the endline survey, we were only able to follow up with 131 of the 141 children (93% of the sample at the baseline). Hence, as shown in Fig. 1, we conducted the endline school readiness test on only 131 children. Although the attrition was not related to the experimental arm assignment, there was evidence that it was not totally random. We find that children who were missing in the endline survey were slightly younger and their mothers more educated (see Appendix Table A1).

Nonetheless, among the 131 children participating in both the baseline and endline surveys, the voucher/CCT and control groups were statistically indistinguishable (in terms of different baseline characteristics – Table 1). First, the key outcome variables (preschool attendance and school readiness test scores) were balanced between the two groups. The average of the school readiness test scores of the voucher/CCT group was higher than that of the control group (this is true for both raw and standardized scores – rows 2 and 3); however, the differences in the averages were not statistically significant from zero. And certainly, given the sampling methods (as described above), none of our sample children attended preschool at the baseline. Second, there was no statistical difference between the two groups of children in terms of eight different measured variables. Specifically, the two groups of children were statistically identical in terms of four different characteristics of the children (age, gender, height and weight) and four different characteristics of their parents (the age and years of education of the mother and father).

In addition to attrition, one potential concern of our RCT is that of a spillover among sample children. For example, a positive spillover of our voucher/CCT intervention might occur if parents who received voucher/CCT told parents in the control group about the intervention, thus encouraging

[2] In this paper we define 4-year-old children to be children who turned 4 years of age between July 1, 2007 and June 30, 2008 (that is, those who were born between July 1, 2003 and June 30, 2004). At the time of our baseline survey (conducted in early July 2008), these children were all at least 4 years old and less than 5 years old.

[3] According to our data (baseline and follow-up household level surveys), these children frequently lived with one or both of their parents who were migrant workers working outside of the county.

[4] Due to the selection criteria, children on the shortlist – from which we randomly selected 150 of them to make up our study sample – did not produce a random, representative sample of the children from the full list. However, children on the shortlist made up a large share of the children in our sample that were really candidates to being influenced by the voucher/CCT intervention. First, there were over 5000 children on the shortlist, about half of the 10,000 children on the full list. Second, it was these 5000 children that made up the shortlist might actually benefit from our voucher/CCT intervention. Specifically, since children on the shortlist were living in the study county, if they were selected to be part of our sample they would be able to actually exercise the voucher/CCT and attend preschool in the county. In addition, children who had already started attending preschool at the time of the baseline (who were also excluded from our shortlist sample), by revealed preferences, would attend preschool anyway (with or without the voucher/CCT). Hence, excluding these children makes sense since the marginal effect of the voucher/CCT intervention on preschool attendance among these children would be negligible (or zero).

[5] Using the Optimal Design software, we calculated that in order to detect a standardized effect size for the outcome variables of 0.35 standard deviations with 80 percent power at the five percent significance level (two-tail test), we would need 67 children in the voucher/CCT group and 67 children in the control group. We assumed a pre- and post-intervention correlation of 0.5.

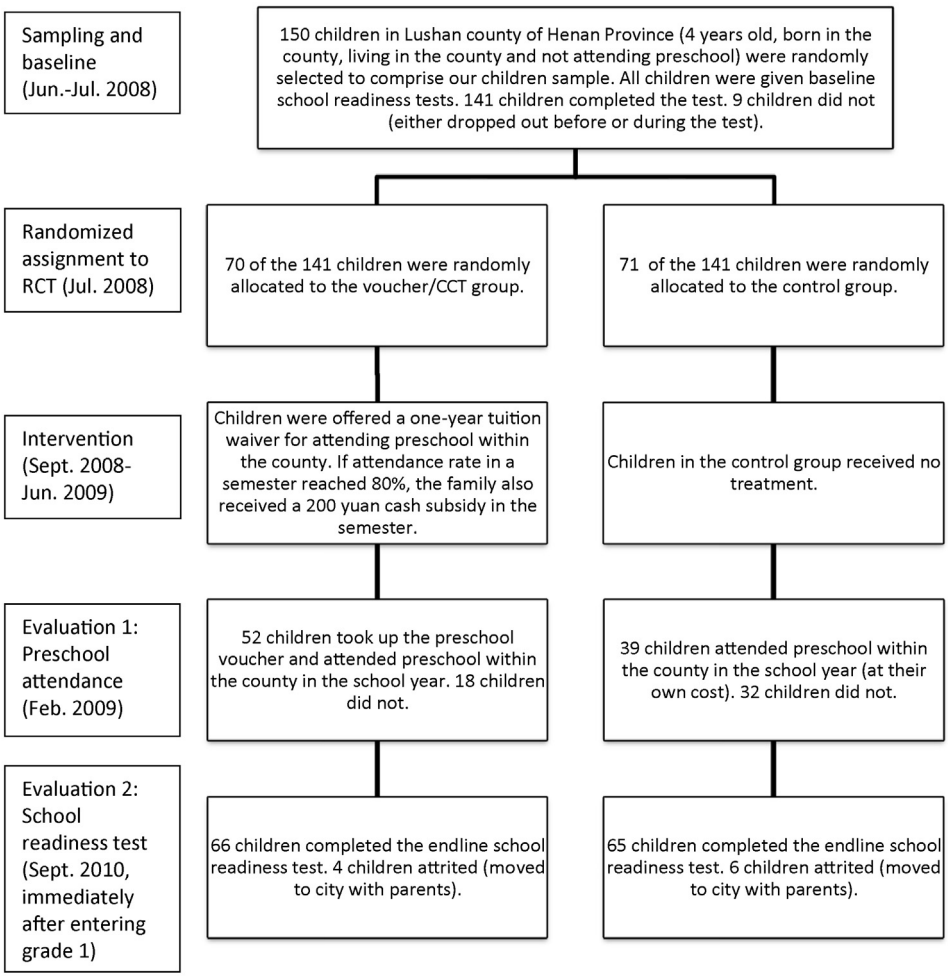

Fig. 1. Profile of randomized controlled trial.

the later to send also their children to preschool. Fortunately, our research design was that spillover was highly unlikely. The 141 sample children came from 76 villages spread across 20 townships in our sample county. There were, on average, less than two families per village. When there were multiple families within a village, the distance between the families was also far – on average 2.5 km apart.[6]

2.2. Intervention/experimental arms

The RCT design included two experimental arms: a voucher/CCT group and a control group with no intervention. In particular, each of the 70 children in the voucher/CCT group received a voucher for waiving preschool tuition up to 300 yuan per semester (tuition in rural areas typically ranges between 150 and 300 yuan per semester) and a cash transfer conditional on attendance (families would receive 200 yuan per semester if attendance reached 80%). Therefore, if a child in the voucher/CCT group attended preschool regularly throughout the one-year intervention period, the household of the child would get a package of benefits close to 1000 yuan (300 + 300 + 200 + 200) in total value (or approximately 160 dollars when using the nominal exchange rate). The value of the voucher/CCT was almost half of the annual rural per capita income in the study county. The intervention therefore served as a large financial incentive for encouraging preschool attendance.

After the allocation of sample children to the two experimental arms, we very shortly called the parents of the voucher/CCT group (or caregivers which could be grandparents or other relatives – henceforth, simply *parents*) informing them that their children were eligible for a preschool voucher/CCT in the coming school year. During the phone call, we told the parents five sets of details about the intervention: (a) the amount of the voucher/CCT, the

[6] In 28 of the 76 villages in the study there was only 1 sample child in the village. Given that, on average, villages in the study county are about 5 km apart, the chance of spillover for children in these 28 villages was essentially zero. In 39 villages (9 villages) there were 2 (3 or 4) sample children in each of the villages. According to the village leaders of villages with multiple sample children, the average within-village distance between the treatment and control families was greater than 2.0 km. In fact, treatment and control children from the same village almost always lived in different residential clusters within the village. Hence, sample children within the same village were not neighbors of each other and the chance of spillover for children in these 48 villages was extremely low.

Table 1
Characteristics of sample children and their parents in the baseline survey in July 2008 ($N = 131$).

	Voucher/CCT group (1)	Control group (2)	Difference (3)	p-Value (4)
Preschool attendance (1 = attended; 0 = if not)	0	0	0 ([a])	[a]
School readiness test scores (raw)	61.0	56.5	4.56 (3.83)	0.25
School readiness test scores (standardized)	0.201	0.000	0.201 (0.168)	0.25
Percentage of female children (%)	47.0	50.8	−3.80 (10.75)	0.73
Child's age (in months)	53.0	53.2	−0.17 (0.65)	0.80
Child's height (in centimeters)	104.4	104.5	−0.13 (1.11)	0.91
Child's weight (in kilograms)	15.3	15.7	−0.41 (0.55)	0.47
Mother's age (in years)	33.6	34.7	−1.11 (0.97)	0.27
Mother's education (in years)	7.0	7.5	−0.42 (0.55)	0.46
Father's age (in years)	35.9	35.6	0.29 (1.71)	0.87
Father's education (in years)	8.2	7.4	0.79 (0.61)	0.21
N	66	65	–	–

Source: Authors' survey.
Note: Robust standard errors adjusted for clustering at the township level are reported in the parentheses.
[a] All sample children did not attend preschool at the baseline so there was no variation in the variable.
[*] Indicates statistical significance from zero at the 10% level.
[**] Indicates statistical significance from zero at the 5% level.
[***] Indicates statistical significance from zero at the 1% level.

conditions associated and a timeline for use; (b) an invitation to the parents to enroll their children into a preschool of their choice within the study county before the semester began on September 1, 2008; (c) a request for the parents to call us back before September 10, 2008 with their choice of preschool if they sent their children to one; (d) a confirmation that every preschool in the county had already been informed of the voucher/CCT arrangement; and (e) a phone number of the research team that the parents could call for matters related to the voucher/CCT. Shortly after the phone call, we also sent the parents a formal letter of notification stating again the same sets of details.

In order to implement the voucher and make the cash transfer, we gathered information about the preschool attendance of children in the voucher/CCT group throughout the school year. Specifically, at the beginning of each of the two semesters (that is, in September 2008 and February 2009), we verified their attendance in the semester with their preschools and asked for the level of tuition in that semester. Within one week then we sent the preschool on behalf of the parents a lump sum of money covering the tuition (up to a maximum of 300 yuan per child). During the final week of each of the two semesters, we asked the principal for children's attendance throughout the semester. If a child's attendance was above 80% (which was almost always the case), we gave the parents a cash transfer of 200 yuan directly at the end of the semester. No other condition or documentation was needed.

The RCT protocol for the control group was simple since there was no intervention. When the semesters begin, we called the parents and asked if they sent their children to preschool. If the answer was yes, we further asked for their choice of preschool. Shortly afterward, we verified the attendance of these children with the principals of the preschools that were mentioned.

2.3. Data collection

There are two primary outcome variables in this study: children's preschool attendance and their school readiness test scores. As described in the previous subsection, children's preschool attendance was measured throughout the school year. Since almost all sample children who attended preschool attended for both of the semesters during our intervention period, in our analysis we use the attendance data during the second semester (as measured in the beginning of the semester in February 2009) to represent children's status of preschool attendance in the school year.[7] Specifically, we create a binary variable *preschool attendance* (attended preschool during the 2008–2009 school year = 1; if not = 0).[8]

[7] In the voucher/CCT invention group for example, 54 of the 70 children attended preschool in the first semester and 52 children attended in the second semester. The difference (2 children) was small and, thus, the choice of preschool attendance data (that is, those in the first or the second semester) does not affect our results.

[8] Children who did not attend preschool typically stay at home and might be given more attention by their parents. However, it is important to note that parents in poor areas of rural China are poorly educated. The quality of parental time and care in poor rural China is almost surely lower than the quality observed in developed countries (e.g., Price, 2010).

Data on the school readiness test scores were collected using a testing instrument created by Dr. Mujie Ou. Dr. Ou is an experienced early childhood education specialist who has studied the growth and development of young children in China for over 50 years (Ou, 1990, 2007). During the past several decades, Ou drew upon extensive international research and testing experiences and developed a set of tests to comprehensively measure the skills and abilities of young children of different age groups in China.[9] Similar to many of the tests commonly used in other countries, Ou's testing instrument measures a set of six different categories of qualities of young children, namely cognitive skills, language skills, communication skills, level of self-management, motor skills of hands and overall physical capacity. Under each of these six categories there are questions that children are asked to answer and tasks that children are asked to perform. In this way, for each child being tested, a *partial school readiness test score* for each of these six categories of qualities is assigned. The sum of all six partial test scores then gives us the *raw school readiness test score* for each child.[10]

Since young children between 3 and 7 years old grow very fast, Ou designed a number of age-specific tests (according to six-month intervals) tailored to the stage of development observed among young children. Based on her work with hundreds of thousands of young children in urban areas of China, Ou was able to produce a similar set of distributions for the raw test scores obtained from each of different age-specific tests. Specifically, Ou benchmarked the tests in such a way that the average of the total scores (that is, the sum of the six partial test scores) is at about 100 points and that most of the children in urban areas score between 85 and 115 points (Hu, Xiao, & Chen, 2009; Ou, 2007). Ou also defined a cutoff of the test (at 70 points) that sets apart children who are considerably "lagging behind in their skills and abilities" and "not ready for school" from their better counterparts. As found in previous studies, only around 3% of young children in urban areas of China scored below this cutoff (Ou, 2007).

In this study, we used two sets of age-specific tests at the baseline (one for 4–4.5 years old and another for 4.5–5 years old) and two other sets of the tests at the endline (one for 6–6.5 years old and another for 6.5–7 years old). Since it was important that the test results were not influenced by intentional preparation for the tests, we made no announcement before the tests, collected all testing instruments at the end of the tests and gave no feedback to anyone after the tests. Furthermore, after the baseline test we mentioned to no one about giving out an endline test in the future. Therefore, we created no incentive for anyone (children, parents, and teachers or principals) to prepare the children for the endline test. In fact, due to the age-specific nature of the tests, the questions and tasks in the endline tests were also considerably different from those in the baseline tests.

In order to make the findings from our test scores comparable, we standardized the raw school readiness test scores and created the variable *standardized school readiness test scores.* The standardized scores were calculated as below:

$$\text{Individual standardized school readiness test score} = \frac{\text{Individual raw school readiness test score} - \text{average of raw school readiness test scores in the control group}}{\text{Standard deviation of raw school readiness test scores in the control group}}$$

In calculating the standardized scores, we used the standard deviation of the raw scores in the control group as the unit of measure for two reasons. First, the use of the "standard deviation" as a unit of measure is a common practice in the economics of education. This conversion from raw scores to standardized scores allows for easier comparisons both to papers using the same readiness test and to papers using other readiness tests. Second, we used the standard deviation of the control group as the unit because raw scores in the control group were not affected by the voucher/CCT intervention. Raw scores in the treatment group, particularly those collected after the intervention, could be affected by the intervention and, as such, should not be used in the standardization.

During the baseline survey we also collected other information about our sample children and their parents. In particular, we collected information on the age, gender, height and weight of the children and the age and years of education of their parents. We also collected other information during the survey from preschool principals and teachers.

2.4. Statistical approach

We use both descriptive statistics and regression analyses to estimate how the preschool voucher/CCT intervention affects preschool attendance and school readiness among young, rural children. In both of these two types of analyses, we control for the clustering of the error terms for observations obtained from the same township.

Our basic regression model is an ordinary least square (OLS) model in an endline-baseline regression setup:

$$Y_{ij}^{endline} = a_0 + a_1 \times Voucher/CCT\ Intervention_{ij} + a_2 \times Y_{ij}^{baseline} + e_{ij} \quad (1)$$

[9] In developing the readiness test for children in China, Dr. Ou consulted in detail several other readiness tests that are widely used internationally. These tests include the Gesell Developmental Schedules (GDS), the Stanford Binet Scale (SBT), and the Denver Developmental Screening Test (DDST). For this reason, the Ou test actually covers most of the key elements found in these three readiness tests. A detailed comparison between the Ou test and these three readiness tests is provided in the manual of the Ou test (Ou, 1990).

[10] While the school readiness test that we use in this paper measures a board set of six different categories of skills and abilities of young children, preschool education may also bring impact on margins that are not measured by our test, such as children's emotional and social development.

where $Y_{ij}^{endline}$ and $Y_{ij}^{baseline}$ are the outcome variables (preschool attendance and standardized school readiness test scores) at the baseline and endline surveys for child i in township j. Of course, all children in our sample were not in preschool at the time of the baseline so the values for the baseline preschool attendance variable for all our sample children were zero. The independent variable, $Voucher/CCT\ Intervention_{ij}$, is a dummy variable that equals one if the child is in the voucher/CCT group and equals zero if the child is in the control group. Therefore, our goal is to test if the estimate for the parameter a_1 (which is the average treatment effect of the voucher/CCT intervention) is positive and statistically significant from zero.

To control for possible observable differences between the voucher/CCT and control groups at the baseline (even though the two groups were statistically identical before the intervention as discussed above), we also ran two sets of adjusted OLS regressions (which we call *adjusted models*). In the first adjusted model, we add to the basic OLS model (as in model (1) above) a set of four variables that measure different characteristics of the child, including child's gender, age (in six-month age groups), height and weight. The model can be written as

$$Y_{ij}^{endline} = a_0 + a_1 \times Voucher/CCT\ Intervention_{ij} + a_2 \times Y_{ij}^{baseline} + a_3 \times Z\_Child_{ij} + e_{ij} \quad (2)$$

where Z_Child_{ij} is the set of child characteristics as described above.

In the second adjusted OLS model, we further control for four different parent characteristics (the age and years of education of the mother and father). The model that includes all these eight variables (four child characteristics and four parent characteristics) is our *fully adjusted OLS model*, which can be written as:

$$Y_{ij}^{endline} = a_0 + a_1 \times Voucher/CCT\ Intervention_{ij} + a_2 \times Y_{ij}^{baseline} + a_3 \times Z\_Child_{ij} + a_4 \times Z\_Parents_{ij} + e_{ij} \quad (3)$$

where $Z\_Parents_{ij}$ is the set of parent characteristics.

In order to improve the precision of the estimations, we also run a series of regressions adjusting for unobserved, time-invariant heterogeneity at the township level. Specifically, when we add a set of township fixed effects, μ_j, to the fully adjusted OLS model (as in model (3) above), we obtain the *fully adjusted township fixed effects (FE) model*:

$$Y_{ij}^{endline} = a_0 + a_1 \times Voucher/CCT\ Intervention_{ij} + a_2 \times Y_{ij}^{baseline} + a_3 \times Z\_Child_{ij} + a_4 \times Z\_Parents_{ij} + \mu_j + e_{ij} \quad (4)$$

In essence, the estimate for a_1 above becomes the average within-township effect of the voucher/CCT intervention net of other factors.

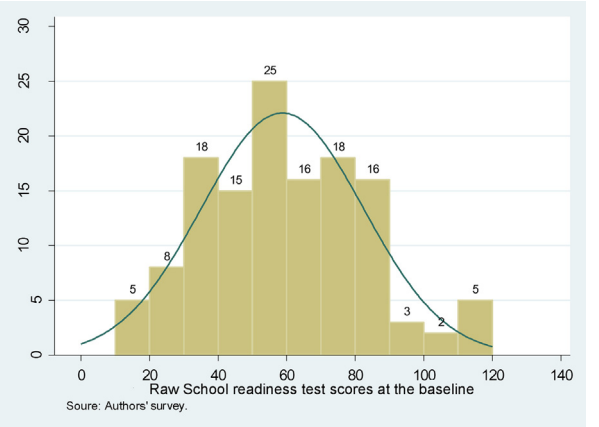

Fig. 2. Distribution of raw school readiness test scores among sample children at the baseline ($N = 131$).

3. Estimates of impacts on preschool attendance and school readiness of children

According to our baseline data, the school readiness among young children in rural areas in China was alarmingly poor. The average raw school readiness test score of all our sample children was only 58.8 points (Fig. 2). Using the cutoff of 70 points, we find that a high share of children in our sample was deemed "lagging behind" and "not ready for school." Specifically, 66% of our sample children (or two out of every three of the young children) scored below the cutoff. We also find that there was a great deal of variations in the test scores. The standard deviation was 23.7 points and the scores were close to being normally distributed.

3.1. Effect of preschool voucher/CCT on children's preschool attendance

The descriptive statistics provide evidence that the voucher/CCT intervention induced young children in rural areas to attend preschool during the intervention period (Table 2). We find that 74.3% of the children in the voucher/CCT group attended preschool (column 3, row 1). The share of the children in the control group was much lower, 54.9% (column 3, row 2). The difference between the two groups of children (19.4 percentage points, or by 35% – column 3, row 3) was statistically significant at the 5% level.[11]

Our multivariate results tell a story that is basically the same as the one suggested by our descriptive statistics. Specifically, when we control for four different child characteristics as described in model (2), the coefficient of the voucher/CCT treatment variable (0.18 – Table 3, column 2) is positive and statistically significant at the

[11] As discussed in the "Data Collection" subsection above, analyses that use preschool attendance data in the first semester of the 2008–2009 school year give results (unreported for the sake of brevity) that are basically the same as those that use the attendance data in the second semester of the year.

Table 2
Preschool attendance of sample children in the baseline and evaluation surveys ($N = 141$).

	Percentage of children attending preschool in the baseline survey (July 2008)	Percentage of children attending preschool in the evaluation survey (January 2009)	Difference between the baseline and evaluation surveys
	(1)	(2)	(3)
Voucher/CCT group	0	74.3	74.3
Control group	0	54.9	54.9
Difference between the voucher/CCT and control groups[a]	–	–	19.4** (7.74) [0.02]

Source: Authors' survey.
Note: Robust standard error adjusted for clustering at the township level is reported in the parenthesis. *p*-Value is reported in the bracket.
[a] Difference-in-differences estimate (between the voucher/CCT and control groups and between the baseline and endline surveys).
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

Table 3
OLS estimates of impact of voucher/CCT intervention on preschool attendance among rural children in Lushan County of Henan Province.

	Dependent variable: preschool attendance at February 2009 (1 = attended; 0 = if not)		
	(1)	(2)	(3)
Treatment variable			
Voucher/CCT group (1 = child in voucher/CCT group; 0 = if not)	0.19** (0.08)	0.18** (0.08)	0.19** (0.09)
Child characteristics			
Female dummy (1 = yes; 0 = no)		0.02 (0.07)	0.01 (0.07)
Child's age group at the baseline (1 = 4.5–5 years; 0 = 4–4.5 years)		0.09 (0.12)	0.07 (0.13)
Child's height (in centimeters)		−0.01 (0.01)	−0.00 (0.01)
Child's weight (in kilograms)		0.01 (0.02)	0.02 (0.02)
Parent characteristics			
Mother's age (in years)			0.01 (0.01)
Mother's education (in years)			0.00 (0.02)
Father's age (in years)			0.00 (0.01)
Father's education (in years)			−0.01 (0.02)
Constant	0.55*** (0.06)	0.92 (0.97)	−0.29 (0.72)
N	141	140	127
R^2	0.04	0.05	0.11

Source: Authors' survey.
Note: Robust standard errors adjusted for clustering at the township level are reported in the parentheses.
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

5% level. This estimate is close to the simple difference-in-differences estimate provided by the descriptive statistics. The results are also basically the same when we further control for different parent characteristics (using model (3) – Table 3, column 3).

The measured impact of the voucher/CCT intervention is again similar when we add a set of township dummy variables to our three OLS models (Table 4). Specifically, the point estimates for the within-township effect of the voucher/CCT intervention in the three specifications are all near 0.20 and statistically significant (columns 1–3, row 1). Taking all statistical evidence above, therefore, we conclude that children who were offered the preschool voucher/CCT were more likely to attend preschool – an increase in the share of children by about 35% (or 20 percentage points).[12]

3.2. Effect of preschool voucher/CCT on children's school readiness

Although the voucher/CCT intervention is shown to induce a higher rate of preschool attendance, we find no evidence that the intervention improved children's school readiness. In the descriptive statistics (Table 5), the raw test scores of children in both the voucher/CCT and control groups increased from the baseline to the endline (panel A, column 3, rows 1 and 2). The increase in the voucher/CCT group was, surprisingly, smaller than that in the control group (by −3.30 points – column 3, row 3). However, this difference was statistically insignificant. The descriptive statistics of the standardized test scores presents basically the same results (Table 5, panel B).

Our multivariate results, like those in the descriptive statistics, show no evidence of impacts of the voucher/CCT intervention. Although the OLS estimates of the voucher/CCT treatment variable in different specifications (model (1)–(3) above) turn positive when we control for the standardized test scores at the baseline, none of the point estimates are statistically distinguishable from zero (Table 6, columns 1–3, row 1). The multivariate results on the standardized school readiness test scores are basically the same when we further control for unobserved, time-invariant heterogeneities at the township level (Table 7, columns 1–3, row 1). Therefore, the voucher/CCT intervention seems to have no measurable impact on the school readiness of young children in poor, rural areas of China.

[12] We have also run a series of regressions that added interaction terms (treatment * control variables of interest) to see if there are different program effects on different subgroups of our sample. In particular, in a series of nine estimations we included the interaction variable constructed by using the voucher/CCT treatment variable and one of the following nine variables: (1) the gender of the child; (2) the age of the child; (3) the age of the mother; (4) the years of education of the mother; (5) the age of the father; (6) the years of education of the father; (7) the presence of a preschool inside the village; (8) the distance to the nearest preschool; and (9) the distance to the nearest township. In the results of each of these nine new estimated regressions, however, the interaction term was not statistically different from zero. Overall, we found no statistical evidence of heterogeneous program effects.

Table 4
Township FE estimates of impact of voucher/CCT intervention on preschool attendance among rural children in Lushan County of Henan Province.

	Dependent variable: preschool attendance at February 2009 (1 = attended; 0 = if not)		
	(1)	(2)	(3)
Treatment variable			
Voucher/CCT group (1 = child in voucher/ CCT group; 0 = if not)	0.20** (0.08)	0.18** (0.08)	0.19* (0.09)
Child characteristics	No	Yes	Yes
Parent characteristics	No	No	Yes
Township fixed effects	Yes	Yes	Yes
Constant	0.72*** (0.03)	2.04 (1.31)	1.21 (1.31)
N	141	140	127
R^2	0.26	0.30	0.35

Source: Authors' survey.
Note: Robust standard errors adjusted for clustering at the township level are reported in the parentheses. Child characteristics include child's gender, age group, height and weight. Parent characteristics include the age and years of education of both mother and father.
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

Table 6
OLS estimates of impact of voucher/CCT intervention on standardized school readiness test scores among rural children in Lushan County of Henan Province.

	Dependent variable: standardized school readiness test scores at the endline		
	(1)	(2)	(3)
Treatment variable			
Voucher/CCT group (1 = child in voucher/ CCT group; 0 = if not)	0.04 (0.16)	0.05 (0.12)	0.01 (0.14)
Child characteristics			
Standardized school readiness test scores at the baseline	0.45*** (0.07)	0.37*** (0.07)	0.35*** (0.09)
Other child characteristics	No	Yes	Yes
Parent characteristics	No	No	Yes
Constant	0.00 (0.15)	−4.88** (1.88)	−5.04** (1.95)
N	131	130	119
R^2	0.30	0.35	0.39

Source: Authors' survey.
Note: Robust standard errors adjusted for clustering at the township level are reported in the parentheses. Other child characteristics include child's gender, age group, height and weight. Parent characteristics include the age and years of education of both mother and father.
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

3.2.1. Analysis of the components of school readiness test scores

Since it is possible that the voucher/CCT intervention increased children's school readiness in certain dimensions but not others (e.g., an improvement in the language skills but not motor skills), we also examine the impacts of the voucher/CCT intervention on the six different partial school readiness test scores (one for each of the six different categories of qualities assessed in our test). Before we conduct these analyses, we have also standardized the partial school readiness test scores in a way that is almost exactly the same as how we have standardized the comprehensive school readiness test scores (see Section 2.3). In Table 8 we report the findings using our adjusted township FE model (as in model (4) above).

Overall, we find no statistical evidence that children's partial school readiness test scores improve with the provision of the voucher/CCT intervention. Although four

Table 5
School readiness test scores of sample children in the baseline and evaluation surveys ($N = 131$).

	Baseline survey (July 2008) (1)	Evaluation survey (September 2010) (2)	Difference between the baseline and evaluation surveys (3)
Panel A: school readiness test scores (raw)			
Voucher/CCT group	61.0	88.5	27.46
Control group	56.5	87.2	30.76
Difference between the voucher/CCT and control groups[a]	–	–	−3.30 (4.37) [0.46]
Panel B: school readiness test scores (standardized)			
Voucher/CCT group	0.20	0.13	−0.070
Control group	0.00	0.00	0.000
Difference between the voucher/CCT and control groups[a]	–	–	−0.070 (0.168) [0.68]

Source: Authors' survey.
Note: Robust standard errors adjusted for clustering at the township level are reported in the parentheses. *p*-Values are reported in the brackets.
[a] Difference-in-differences estimates (between the voucher/CCT and control groups and between the baseline and evaluation surveys).
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

Table 7
Township FE estimates of impact of voucher/CCT intervention on school readiness test scores among rural children in Lushan County of Henan Province.

	Dependent variable: standardized school readiness test scores at the endline		
	(1)	(2)	(3)
Treatment variable			
Voucher/CCT group (1 = child in voucher/ CCT group; 0 = if not)	−0.03 (0.17)	−0.01 (0.14)	−0.03 (0.16)
Child characteristics			
Standardized school readiness test scores at the baseline	0.48*** (0.08)	0.41*** (0.08)	0.43*** (0.11)
Other child characteristics	No	Yes	Yes
Parent characteristics	No	No	Yes
Township fixed effects	Yes	Yes	Yes
Constant	−0.03 (0.06)	−3.71 (2.43)	−2.19 (2.69)
N	131	130	119
R^2	0.44	0.48	0.54

Source: Authors' survey.
Note: Robust standard errors adjusted for clustering at the township level are reported in the parentheses. Other child characteristics include child's gender, age group, height and weight. Parent characteristics include the age and years of education of both mother and father.
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

Table 8
Township FE estimates of impact of voucher/CCT intervention on six different partial school readiness test scores among rural children in Lushan County of Henan Province (N = 119).

	Coefficients of voucher/CCT treatment variable (1 = child in voucher/ CCT group; 0 = if not)	R^2
	(1)	(2)
Dependent variables: standardized partial readiness test scores at the endline (as below)		
Cognitive skills test scores	−0.32* (0.17)	0.56
Language skills test scores	0.25 (0.24)	0.56
Communication skills test scores	0.15 (0.19)	0.62
Level of self-management test scores	0.10 (0.27)	0.66
Motor skills of hands test scores	−0.02 (0.23)	0.87
Overall physical capacity test scores	0.11 (0.19)	0.68

Source: Authors' survey.
Note: Child characteristics, parent characteristics, township fixed effects and a constant are included in each of the six separate regressions. Child characteristics include child's gender, age group, height, weight and corresponding standardized partial test scores at the baseline. Parent characteristics include the age and years of education of both mother and father. Robust standard errors adjusted for clustering at the township level are reported in the parentheses.
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

of the six coefficients on the voucher/CCT treatment variable are positive, the coefficients are all not statistically different from zero. One of the six coefficients (the one for the motor skills of hand – row 5) is almost exactly zero. In the case of the cognitive skills, somewhat surprisingly, the voucher/CCT intervention may actually bring a negative impact on children (point estimate is −0.32, statistically significant at the 10% level – row 1).

While we do not have definitive evidence on why the intervention might have found a negative result on children's cognitive scores, we believe that the poor quality of preschool education in rural China might have been the main reason. In particular, the lack of qualified preschool teachers and educational resources might limit the cognitive development of young children, affecting how young children acquire knowledge, process new information and relate themselves to abstract concepts. These children, instead of being at home under the care of their parents or caregivers, are being put in schools with little stimulation. We will discuss in greater details the poor quality of preschool education in rural China in the final section of this paper.

3.3. Effect of preschool attendance on children's school readiness

Although in the analysis above we find a lack of positive impact of our voucher/CCT intervention on school readiness, it is not equivalent to showing that preschool attendance itself brings no benefit. In this subsection, we examine the impact of preschool attendance on children's school readiness using an instrumental variable (IV) approach. Specifically, we exploit the fact that the voucher/CCT intervention was randomly assigned among sample children and use our treatment variable *Voucher/CCT Intervention* to instrument for the endogenous dummy variable *Preschool Attendance*.

The first stage of the IV estimation is essentially the same as those in Section 2.4. In particular, in our IV estimation we use a township fixed effects model similar to model (4) above:

$$\begin{aligned} Preschool\,Attendance_{ij}^{endline} &= a_0 + a_1 \times Voucher/CCT\,Intervention_{ij} + a_2 \\ &\times School\,Readiness_{ij}^{baseline} + a_3 \times Z\_Child_{ij} + a_4 \\ &\times Z\_Parents_{ij} + \mu_j + e_{ij} \end{aligned} \tag{5.1}$$

We obtain from the estimation of model (5.1) the predicted values of preschool attendance for each of the children, namely the *Predicted Preschool Attendance*. We then use these predictions in the right hand side of the second stage of the IV estimation:

$$\begin{aligned} School\,Readiness_{ij}^{endline} &= b_0 + b_1 \times Predicted\,Preschool\,Attendance_{ij} + b_2 \\ &\times School\,Readiness_{ij}^{baseline} + b_3 \times Z\_Child_{ij} + b_4 \\ &\times Z\_Parents_{ij} + \mu_j + e_{ij}. \end{aligned} \tag{5.2}$$

Table 9
IV estimates of impact of preschool attendance on standardized school readiness test scores among rural children in Lushan County of Henan Province.

	Dependent variable: standardized school readiness test scores at the endline (1)
Independent variable	
Preschool attendance (1 = attended; 0 = if not); instrumented by voucher/CCT group variable (1 = child in voucher/CCT group; 0 = if not)	−0.11 (0.72)
Child characteristics	
Standardized school readiness test scores at the baseline	0.42*** (0.13)
Other child and parent characteristics	Yes
Township fixed effects	Yes
Constant	−1.84 (2.93)
N	119
R^2	0.54

Source: Authors' survey.
Note: Robust standard errors adjusted for clustering at the township level are reported in the parentheses. Other child characteristics include child's gender, age group, height and weight. Parent characteristics include the age and years of education of both mother and father.
* Indicates statistical significance from zero at the 10% level.
** Indicates statistical significance from zero at the 5% level.
*** Indicates statistical significance from zero at the 1% level.

The estimate for b_1 is the average within-township treatment-on-the-treated effect (also called the local average treatment effect) of preschool attendance on school readiness net of other factors.

3.3.1. Results from instrumental variable analysis

As the first-stage results are already shown in Section 3.1, here we only report the results obtained from the second stage of the IV estimation (Table 9). Overall, the results from our IV estimation do not support a story that preschool attendance raises school readiness. The coefficient of the predicted preschool attendance variable is, somewhat surprisingly, negative (point estimate at −0.11, although statistically insignificant from zero – row 1). In other words, the finding in the IV estimation here is along the line with our earlier findings that our voucher/CCT intervention does not promote school readiness. In fact, the impact of preschool attendance might even be negative (although the statistical inference is not precise).

4. Discussion and conclusion

In this paper we have demonstrated that two-thirds of young children in our study county have skills and abilities that are insufficient for them to succeed in elementary school. In a competitive school system like the one in China, children who fall behind early in school (or even before they go to school) almost certainly will be always behind. We find strong evidence in our RCT that providing children with a voucher/CCT can raise preschool attendance. Clearly as a policy tool to raise attendance, the voucher/CCT program has great potential. However, in both the descriptive statistics and multivariate analyses, we find no evidence of positive impacts of the voucher/CCT intervention or preschool attendance on children's school readiness. While we cannot provide definitive evidence on why this might be the case, in this section we provide two possible explanations.

First, as suggested earlier in the paper, one possible explanation is the poor quality of teaching among preschools in China's poor, rural areas. In rural China the quantity and quality of preschool teachers are often far from being sufficient. In the survey also conducted by our team in 2008 in six poor, rural counties in China (including the RCT county in this study – see Luo et al., 2012, for more details), we found that the children-to-teacher ratio among preschools in rural areas was very high – 29:1. This ratio was much higher than the ratios (at around 10:1) observed in an informal survey of urban preschools conducted by the authors in Beijing, Xi'an and Chengdu. The quality of preschool teachers in rural China was also typically low. According to Luo et al. (2012), only 12% of the preschool teachers in their six-county study actually had formal certificates or training in fields related to preschool education. However, while there was a serious shortage of qualified teachers in many rural preschools, preschool principals and operators were often unable to hire more teachers with proper qualifications due to a lack of financial resources.

A second possible explanation of the lack of positive impacts of the voucher/CCT intervention or preschool attendance on children's school readiness is related to poor preschool environment and facilities. As the six-county study also showed, many preschools in rural China were not providing a suitable environment for activities important to the growth and development of young children. Specifically, only two-thirds of the preschools were convened in buildings that met basic educational needs. The other one-third of the preschools simply operated in private residences, abandoned village-owned structures or other facilities that were built for non-educational uses (such as market activities). Some of the preschools were even located in neighborhoods that were unsafe for young children to go around (such as those that located in the proximity of factories or unfenced fish ponds). Also, the facilities of rural preschools were often insufficient to promote child development. The indoor ventilation and lighting conditions were bad. Desks and chairs did not match the height and size of young children (in some cases preschools received broken furniture thrown out by nearby elementary schools). Basic educational materials and learning tools (such as painting supplies, simple musical instruments and sports equipment) were not always found. Given the poor environment and the poor facilities in many preschools in rural China, it might not be surprising that preschool education did not bring improvement to children's school readiness.

Taken together, we offer two policy recommendations on the investment into preschool education in poor areas of rural China. First, the government should provide more financial resources to help young children in poor rural areas attend preschool. We estimate that there are roughly

6 million children aged 4 and 5 in the 592 counties designated by the central government as poor counties (those that are the poorest in China and receive special poverty alleviation efforts from the central government). If each of those 6 million children were given a voucher/CCT (which in our case would cost at most 1000 yuan per children per year), and if 75% of those children would exercise the voucher/CCT, the annual cost of such a preschool program would be around 4.5 billion yuan (or 0.72 billion dollars using the current nominal exchange rate). The per capita cost of such a voucher/CCT program is actually comparable to the cost of the national Nutritious School Lunch Program (which annually costs 16 billion yuan or 2.5 billion dollars among 26 million primary and middle school children in nearly 700 counties – China Daily, 2012). Hence, if the quality of preschool in poor areas could be improved in ways that can actually benefit young children, such a voucher/CCT program for preschool attendance seems to be affordable and worth funding.

Second, the government should invest heavily into the teaching, environment and facilities of preschools to make preschool education truly value-adding. There should be enough preschool teachers equipped with proper qualifications and training. Preschools should locate in buildings that are safe for young children and should have sufficient facilities for educational activities. Preschool classes and activities should also be well-planned, engaging and stimulating. In fact, there is a great need of more comprehensively and systematically evaluating the quality of preschools in rural China so that future investments into rural preschools can be better targeted. Government officials should work with education researchers to measure the quality of preschools with validated and well-known assessment schemes such as the CLASS (Classroom Assessment Scoring System) and the ITERS (Infant-Toddler Environment Rating Scale).

As a final note, we must caution readers that further study is also needed to determine the overall impact of higher preschool attendance by only scaling up the voucher/CCT program (that is, running a program that is similar to ours and does not include specific measures to improve preschool quality). On the one hand, it is possible that simply scaling up the voucher/CCT program could lead to overcrowded preschools that might further lower preschool quality (at least in per capita measures such as children-to-teacher ratio) and, as such, also negatively affect children's school readiness. On the other hand, a scaled-up voucher/CCT program could also improve preschool finance through a higher level of attendance. With more revenue from tuition and other fees, rural preschools might be able to make more investments in the long run. Preschool quality might thus improve and preschools might be able to benefit young children. In turn, of course, this could also attract more attendance at preschool.

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Appendix

See Appendix Table A1.

Table A1
Baseline characteristics of sample children and their parents between attrited and non-attrited children ($N = 141$).

	Attrited children (1)	Non-attrited children (2)	Difference (3)	p-Value (4)
Preschool attendance (1 = attended; 0 = if not)	0	0	0 ([a])	[a]
Percentage of children in voucher group (%)	40.0	50.4	−10.4 (16.6)	0.54
School readiness test score (raw)	58.6	58.8	−0.15 (8.13)	0.99
School readiness test score (standardized)	0.085	0.101	−0.017 (0.350)	0.96
Percentage of female children (%)	40.0	48.9	−8.85 (16.18)	0.59
Child's age (in months)	50.8	53.1	−2.30** (0.82)	0.01
Child's height (in centimeters)	103.4	104.4	−1.07 (1.57)	0.50
Child's weight (in kilograms)	15.4	15.5	−0.12 (0.69)	0.86
Mother's age (in years)	35.6	34.1	1.47 (2.45)	0.55
Mother's education (in years)	8.6	7.2	1.39*** (0.44)	0.01
Father's age (in years)	35.9	35.7	0.18 (2.11)	0.93

Table A1 (*Continued*)

	Attrited children (1)	Non-attrited children (2)	Difference (3)	*p*-Value (4)
Father's education (in years)	7.3	7.8	−0.47 (1.05)	0.66
N	10	131	–	–

Source: Authors' survey.

Note: Robust standard errors adjusted for clustering at township level are reported in the parentheses.

[a] All sample children did not attend preschool at the baseline so there was no variation in the variable.

[*] Indicates statistical significance from zero at the 10% level.

[**] Indicates statistical significance from zero at the 5% level.

[***] Indicates statistical significance from zero at the 1% level.

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