EFFECTS OF CHOICE OF EARLY CHILDHOOD EDUCATION AND CARE ON COGNITIVE AND NON-COGNITIVE ABILITY IN JAPAN[1]

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We estimate the effects of different types of preschools — educational (kindergarten) and care-oriented preschools (nursery schools) — on cognitive and non-cognitive outcomes in Japanese children (Grades 1–9) using new national representative data set, Japan Child Panel Survey (JCPS). It is found that children from kindergarten perform better than children from nursery school in Japanese language by 0.24SD and in math by 0.28SD. Much of the differences remain after adding a set of family and demographic variables. However, based on an instrumental variable (IV) estimation using the municipality level probability to attend each type of school and female employment rate as IVs, we do not able to find statistically significant differences in the outcomes. Therefore, the differences in the cognitive outcomes across children who attended different types of preschools are unlikely to be caused by the types of schools. We also performed the same estimation on the total difficulty and QOL scores of children, and we found no difference in both OLS and IV estimation across types of preschools.

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I. INTRODUCTION

1.1 Overview

Strengthening the education of young children is a priority of education policy reform. In economics, there has been an increase in theoretical and empirical studies focusing on this issue, triggered by the results of the Perry Preschool Program (Barnett 2004), Head Start (Currie and Thomas 1995), Abecedarian Project (Ramey et al. 2000), and a series of papers by Heckman et al. (2010a; 2010b). Research has focused on the types (cognitive or non-cognitive), size, and duration of effects of interventions, and their optimal timing in the course of child development (Currie 2001; Magnuson and Duncan 2013).

There has also been a corresponding interest in the types of preschools that most positively affect the overall development of children. Given the difficulty of defining the quality of childcare or preschools in terms of "inputs" (Blau 2001), outcomes of children who have attended different institutions have been examined. This strategy has also been found difficult, because research, mostly conducted in the United States, has seen mixed results, especially with non-cognitive outcomes (Figlio and Roth 2009).

Different countries have different types of preschools for historical reasons. One way to distinguish between the diverse characteristics of preschools is to divide them into

"education oriented" and "care oriented" by focusing on their primary purpose, length of care, characteristics of target families, and contents of curriculum. Faced with an increase in working mothers in developed countries, an important question for policy makers is whether the educational quality of care-oriented preschools can be improved, and if so, how this should be done. There are, however, few studies that have investigated the effect of type of preschool on child development. One reason for this may be that the type of preschool attended, whether educational or care-oriented, is rarely included in survey data. Even if it is included, answers are usually self-reported, and may not be accurate because there is no universally-agreed definition of these terms.

In this paper, we investigate whether different types of preschools, part-time "education oriented" and full time "care oriented," produce different outcomes for children. Using alternative estimation measures we focus on cognitive and non-cognitive development using recent data from a national representative sample of children in Japan.

Japan has a dual preschool system with education-focused and care-oriented institutions separately regulated and funded. Faced with a shortage of full-time childcare places, there is debate over whether the government should relax the

minimum standard for full-time childcare in favor of increased availability of places for children. Because of the difficulty to monitor or evaluate daily activities of children in the classrooms, there are concerns that the educational quality of nursery schools may not be of the same standard as in kindergartens. To date, no study has evaluated the effects of different types of preschools on outcome measures in children.

In section 1, we provide background information about the Japanese preschool system, current policy debate, and the contribution of this paper to the literature. Section 2 details the design of the data set, its construction and choice of variables, and the sample selection. Section 3 explains our empirical strategy. We use both ordinary least squares (OLS), and instrumental variable method (IV) under alternative specifications and conditions to gain information about the robustness of our estimation results. Section 4 summarizes the results from these estimation methods. Based on OLS, we found that children whose parents enrolled them in kindergarten significantly outperform children whose parents chose to send them to nursery school in cognitive outcomes but not in non-cognitive outcomes. The results of IV estimation, however, suggests that the differences found in OLS estimation may not mean causal relationship. Section 5 provides a conclusion and suggests future directions for the research.

1.2 Institutional Background

All Japanese children, aged 6 years on 1st April, must attend elementary school. Elementary schools have a 6-year curriculum, after which children attend junior high school for 3 years. Prior to this 9-year compulsory education, many children attend preschools. Two- or three-year part-time kindergartens and full-time nursery schools are Japan's two major preschool choices, and each is characterized by different purposes and characteristics. Kindergartens originally intended to help pre-school children, aged 3–5, "develop their mind and body by providing a sound educational environment", over a 2- to 3-year period. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) controls the curriculum of kindergartens, and teachers in these schools must obtain the Ministry's certification.[2]

Nursery schools, conversely, were originally intended to provide "care for children whose parents (or equivalents) could not provide childcare because of work or other reasons." The Ministry of Health, Labour and Welfare sets the guidelines for nursery schools, and these providers must obtain the Ministry's certification as a "childcare person." [3] Nursery schools must comply with the guideline to be "certified" to receive

[2] The education standard for kindergarten curriculum and teachers was established in 1900 within the Elementary School Order.
[3] The minimum standard for nursery schools and childcare persons was first set in 1948 after the *Child Welfare Act* established that protecting and nurturing children who lack sufficient care from their own family is the government responsibility.

the subsidy. Nursery schools provide educational services as well as childcare for children 5 years of age and younger.

Although these two types of preschools have different initial purposes and administrations, their roles overlap in many ways. Both provide education to preschoolers, and some consider the two types of schools roughly equivalent.[4] Table 1 shows the enrollment rate at kindergarten and nursery schools in Japan (MEXT 2013). Overall, the enrollment rate of children aged 4–5 years is 94%, and nearly 57.8% of these children attend kindergarten. The enrollment rate of 3-year old children is lower at 78%. Japan is ranked 18th among 35 developed countries (OECD 2013). Of the 3-year old enrolled children, 52% attend kindergarten. This is lower than the ratio for 4- and 5-year-old children, because a significant number of kindergartens offer only 2-year programs.

(Insert Table 1 here)

Japan has both public and private kindergartens and nursery schools. Private kindergartens must follow the same governmental guidelines as the public kindergartens, although they have more freedom in the curriculum followed and

[4] Currently, the Japanese government is in the process of integrating these two preschool education institutions into one. MEXT is encouraging the use of a system established in FY2006 called "Center for Early Childhood Education and Care," which provides unified education and childcare, and an Action Program for Pre-School Education Promotion. We ignore this type in our analysis because no respondent reported in our data set having attended this type of preschool.

admission policy. Public kindergartens are financed by municipalities, and generally charge lower tuition fees than private kindergartens. Private nursery schools are more diverse: any private organization can run a nursery school. However, to receive a subsidy from the municipality, they would need to have been established as a non-profit organization, and have to satisfy the same governmental guidelines as public nursery schools. Therefore, similar to kindergartens, "certified" private nursery schools are expected to meet the same minimum quality as public nursery schools. Tuition fees at certified nursery schools, whether public or private, are locally controlled. A means-tested tuition schedule is applied based on family income. [5]

Reforming preschools has become one of the main priorities for education and family policy agendas in Japan. There are at least three reasons for this. First, there is a dramatic increase in the demand for full-time, high-quality preschool education, reflecting the increased participation of educated women in the labor force. Second, there has been a reassessment of the importance of the preschool period for later human capital development, and there is a movement toward shifting educational investment to young children in developed countries (OECD 2011). Third, it is recently found that the country's poverty rate among single parents is among the worst as a developed

[5] In contrast, "uncertified" nursery schools with no government subsidy or regulation set their own tuition fees.

country. The public has recognized that availability of high-quality preschools, especially on a full-time basis, is essential for preventing potential intergenerational reproduction of poverty that can emerge as a result of lack of opportunity to experience an adequate learning environment for children and lack of earning opportunities for their parents.

1.3 Literature Review

The importance of early childhood investment has been emphasized by social experiments such as the Perry Preschool Programs (Barnett 2004) and a theoretical underpinning of human capital development of children that tries to reconcile recent empirical findings in economics and psychology (Carneiro and Heckman 2003). Evidence of the effects of preschool education is abundant in the United States; however, there are few empirical studies that have investigated the effects of types of preschools on children's outcomes. Magnuson et al. (2007) investigated the effect of educational preschool ("pre-kindergarten") on short-term behavioral outcomes using Early Childhood Longitudinal Study data in the United States. They found that participation in pre-kindergarten was associated with more behavior problems in the first grade. Figlio and Roth (2009) used Florida administrative data and investigated the effects of the Head Start program and public pre-kindergarten on a set of behavioral outcomes,

controlling for family fixed effects. They found that public pre-kindergarten attendance reduces behavioral problems in elementary school, especially for children from disadvantaged neighborhoods.

Our empirical research, focusing on Japanese children, has two contributions pertinent to the local context, and one that is relevant on an international scale. First, in Japan, there have been no systematic studies about the relationship between types of preschools and cognitive and non-cognitive outcomes.[6] We tackled this topic using the first national representative panel survey of children, the Japan Child Panel Survey (JCPS), which contains rich information about children's cognitive and non-cognitive outcome measures as well as demographic and family background information and preschool education experiences of children.[7]

Second, there is a further international implication of analyzing the effects of preschools in Japan. In Japan, it is illegal to use a name that confuses users about the type of institution so that kindergarten and nursery schools have long been recognized as clearly distinct institutions simply by their names. Parents and children can usually

[6] The Japanese Government (MEXT) released the official report of the National Achievement Test in 2009, with a finding that Japanese and mathematics test scores were higher among children who went to kindergarten than among children who went to nursery schools. However, there has been no further statistical analysis released from the MEXT.

[7] Akabayashi and Tanaka (2013) assessed the relative contribution of nationwide expansion of kindergarten and nursery schools on high school and college attendance using regional data.

remember which type of preschool was attended simply by recalling the name. Because curricula and teacher qualifications are nationally controlled, it is expected that the quality of preschools is standardized at least within each type. In the United States, a problem described by Magnuson et al. (2007) is that parents often cannot identify the type of preschool their children attended, and there can be a high degree of measurement error in the data of preschool type. In the United States, the naming of preschools is not regulated and there is no national standard in the curriculum, both of which make the identification of type of preschool based on parental response difficult.[8] Institutional rigidity and curriculum uniformity in the Japanese context is an advantage when estimating the effects of types of preschools on later outcomes in the population.

II. DATA

2.1 Japan Child Panel Survey (JCPS)

The JCPS is a longitudinal parent-child survey initiated in 2010 by the Panel Data Research Center (PDRC) at Keio University. It was designed as a supplement module to the Japan Household Panel Survey (JHPS) and the Keio Household Panel Survey (KHPS), two comprehensive household surveys initiated in 2004 (KHPS) and in 2009

[8] Figlio and Roth (2009) overcame this problem by focusing on the effects of clearly defined public pre-kindergarten on disadvantaged children, leaving private preschools beyond the scope of the analysis.

(JHPS). [9]

The JCPS participants were parents of children enrolled in elementary (grades 1–6; aged 6–12 years) or junior high school (grades 7–9; aged 12–15 years), as well as the children themselves. The PDRC conducts JCPS surveys with the JHPS and KHPS adult samples on alternate years. Participants in the JHPS 2010 were invited to participate in the first JCPS survey (2010). The second JCPS survey (2011) targeted participants from the KHPS 2011, the third JCPS survey (2012) targeted participants from the JHPS 2012, and the fourth JCPS survey (2013) involved participants from the KHPS 2013. Figure 1 summarizes the JCPS, JHPS, and KHPS timeline structure.

(Insert Figure 1 and Table 2 here)

Table 2 shows the potential number of households/children who could participate in the JCPS, the children's birthdates, the number of households/children who actually participated, and the response rates by household and child units, respectively.

The JCPS survey form consists of a children's form and a parents' form. The children's form includes children's basic academic ability tests in the subject areas of Japanese and mathematics (Shikishima et al. 2009). The form also includes questionnaires related to schools, studies, and subjective quality of life (QOL). The questions related to

[9] For more background information, see Akabayashi et al (2016a).

Japanese and mathematics differed for each grade. With respect to academic ability tests, the same batteries were used for each of the different years.[10] For questionnaire items, questions related to QOL were introduced for children enrolled in Grade 3 and above. Children had to complete the academic ability test by themselves within 20 min. Children were asked to complete the questionnaire independently after completing the test. They were then asked to give the completed forms to their parents.

Parents completed the parents' form. The same questionnaire was given to all parents irrespective of their child's grade. Parents were asked to respond to questions related to educational environments, parenting, and children's sociality and problem behaviors for each of their children.

2.2 Construction of Key Variables and Sample Selection

We used test scores for Japanese and mathematics as cognitive measures. For non-cognitive measures, sociality and QOL were used as outcome measures. For cognitive measures, we transformed the individual total test scores to factor scores by categorical factor analysis.[11] We then normalized the scores with the mean being zero

[10] The reliability and validity of the academic ability test was verified elsewhere (for details of the academic ability test, see Shikishima et al., 2013). The internal consistency of each grade's test using Cronbach's α ranged from 0.84 to 0.94 (M=0.88) for Japanese and 0.76 to 0.93 (M=0.87) for mathematics. See Akabayashi et al. (2013), Akabayashi, Naoi, Shikishima (2016b) for initial findings about the effects of family background on cognitive outcomes.

[11] Categorical factor analysis is a sub-model of structural equation modeling. See Appendix 1 for more details.

and the standard deviation being 1, and used in the following analysis.

Children's sociality was assessed based on responses provided by parents on the Strengths and Difficulties Questionnaire (SDQ; Goodman 1997) for each child enrolled between the 1st and 9th grades. SDQ is a 25-item Likert-style psychometric scale that asks parents to rate children's difficulties in the subscales of "emotional symptoms", "conduct problems", "hyperactivity/inattention", and "peer relationship problems". Each subscale is measured with five items and the total score for the five items was used as the score for each subscale. The summed score of the four subscales comprises the score for "total difficulties". "Prosocial behavior" was measured on an additional five items and the total score for the five items was used. This questionnaire has been employed by the Ministry of Health, Labour, and Welfare as a continuous variable scale to screen children for problematic behaviors and to discover mild developmental disorders (Matsuishi et al. 2008). In this analysis we focus on the total difficulty score.

The subjective QOL of children enrolled in the 3rd Grade and beyond was measured through self-report. Two editions of "KINDL^R" (Ravens-Sieberer et al. 2006), a QOL scale for children developed by Bullinger et al. (1994), were used: the elementary school children's edition and the junior high school children's edition (Matsuzaki et al. 2007). KINDL^R measures QOL based on six subscales: "physical health," "emotional

well-being," "self-esteem," "family," "friends," and "school." It is a 24-item Likert-style psychometric scale that measures each of these areas through the use of four items. The total scores represent children's general QOL scores. In this paper we focus on the total score of QOL.

Our main treatment dummy variable is "Attended Kindergarten" as opposed to "Attended Nursery School." There are very few children who attended both and few children who did not attend any. In the few cases where this did occur, children were excluded from the sample. We also obtained information about the provider of the preschool (public or private).

In the regression analysis, we included variables that potentially affect both children's outcomes and preschool choice by parents as controls. We always controlled for the following variables: Child's grade group dummies (4th–6th Grade, 7th–9th Grades, with 1st–3rd as reference), female child, number of siblings, birth in 4th quarter (child's birthday between 1st January and 1st April = 1), mother's age at birth, single parent family, father is more than high school graduate, mother is more than high school graduate, dummy variables for family income group by quartiles, and survey year dummies.

We used the sample with valid values for all the variables. Because of the panel

structure, we have at maximum three observations for each child. In the analysis we include all the observations, and we correct for the unobserved correlation across multiple observations for each child whenever appropriate.

The final sample size is 2,677 for estimation of cognitive measures. Because SDQ and QOL were not evaluated in 2010, the sample size for these estimations is smaller, and is 2,262 and 1,758, respectively.

III. EMPIRICAL STRATEGY

We first present results of a variety of specifications that take into account the differences between private and public institutions, and years of preschool attendance using OLS. We are aware that parental choice of preschool can be influenced by both observed and unobserved characteristics of family and children. Choice of preschool is multidimensional, e.g., parents need to consider types of schools, age of enrollment, length of hours, and a choice of private or public school. We focus on the choice between nursery schools and kindergarten because it would be difficult to analyze the effect of other characteristics at one time given the modest size of the sample.

Children who attend educational preschool may perform better, not because those institutions give a higher quality education, but because they are better prepared even without attending preschool, because of both observed and unobserved reasons. Without

accounting for those reasons, any positive statistical association between the choice of preschool and children's outcome can be spurious.

Our strategy is to apply instrumental variable estimation methods to uncover the causal effects of the choice of types of preschool education. In Japan, the availability of preschools greatly vary across regions (Akabayashi and Tanaka 2013). We use municipality-level yearly statistics of 5-year old enrollment at each types of preschools.[12] The probability of attendance is calculated dividing the enrollment at each types of preschools by the grade 1 enrollment next school year at municipality level.

Another potential determinant of the type of preschool is the mother's work status. Since nursery school is full-time service, dual-earning couples are likely to choose nursery school over kindergarten. Therefore, the local availability of each type of school and local female labor force participation rates are considered to be potential candidates of instrumental variables for the choice of preschool type. With this additional instrument, we apply the generalized method of moment (GMM) estimation.

In order for our IV strategy to uncover the causal effect of types of preschool on

[12] Ideally, the availability of preschool should be measured by the capacity, rather than the enrollment. However, we have not found any data for kindergarten capacity by age, Total capacity data is available for nursery school at municipality level, but they are not separated by age. Another candidate of instrument may be the number of schools at municipality level, which we may explore to see the robustness of our results in the future.

cognitive and non-cognitive outcomes of children, the following conditions have to be satisfied: (1) local attendance rates to each type of preschools are exogenous to later outcomes of children. (2) local female employment rate is exogenous to later outcomes of children.

One may want to question whether either or both instruments are truly exogenous, since they may also be endogenously influenced by local work and education culture, which are also potential determinants of the choice of preschools for parents. The first answer is that although private schools tends to be established responding to the demand, public schools are likely to be politically established, which are likely to be exogenous. The second answer is that we indirectly check the possibility that they are endogenous variables through the overidentification test. [13]

Since our data set potentially includes multiple observations from each individual and each family if there are multiple children, it is crucial to allow the correlation of errors across the observations within each individual or each family. Since there is no clear theoretical reason to guide which clustering is better, we basically allow clustering at individual level, adding the results under clustering at family level as robustness

[13] Further robustness check can be done by through prefecture fixed effect model assuming that prefecture dummy can absorb some of the cultural influence that can potentially bias our estimation results. Our preliminary results not shown here suggest that fixed effect estimates are fundamentally similar to the current results.

check.

IV. EMPIRICAL RESULTS

4.1 Characteristics of Children from Kindergarten and Nursery School

Table 3 shows the summary statistics of the key variables used in the analysis for children who went to kindergarten and children who attended nursery schools. We also performed tests on the equality of means of the variables between the two groups.

Based on the test results, it was found that children who went to kindergarten differ from children who went to nursery school in that the former group are more likely to have (1) attended private preschool, (2) attended preschool for a shorter duration, (3) been born to older mothers, (4) both parents present, (5) a higher family income, and (6) higher scores in Japanese and mathematics. The probability of enrollment at nursery school may be higher for single parents because they have a priority of enrollment at nursery schools.

(Insert Table 3 here)

In summary, regarding children's outcome variables, although the test scores for Japanese and mathematics are significantly higher in children who went to kindergarten, in almost all non-cognitive variables, a significant difference between the two groups did not exist. Further, the choice of types of preschool appears to be strongly

influenced by the child's family background.

4.2 Estimation Results based on OLS

In this section, we present the results of estimation of the effects of types and years of preschools on a variety of outcomes using OLS under a variety of specifications.

Table 4 reports the estimates for Japanese and mathematics. Table 5 reports the selected estimates for the total difficulty score and the QOL total. All estimation was done using seven different specifications based on simple OLS. Model 1 includes only the kindergarten dummy variable without any other covariates. Model 2 is the estimation that includes an extensive set of demographic and family background variables. Model 3 adds the kindergarten dummy variable and the years of total preschool attendance, regardless of preschool type. Model 4 is the estimation that includes three separate dummy variables: public kindergarten, private nursery school, and private kindergarten with public nursery school attendance as a baseline category. Model 5 includes an interaction variable, Kindergarten dummy x grade level, to allow for changes in the effect of kindergarten over time. Model 6 includes an interaction variable, Low income family dummy x Kindergarten dummy, to allow for a differential effect of kindergarten across income groups. "Low income family" is defined to take 1 for a child whose family income is lower than the sample median.

(Insert Table 4 here)

Model 1 shows that children who attended kindergarten perform better than children who attended nursery school in Japanese and mathematics from 0.24 or 0.28 of the standard deviation. When we add a set of demographic and family background variables in Model 2, the size of the estimates on the kindergarten dummy is reduced by about 11–12%. However, the effects of kindergarten are still statistically significant.

Although Model 3 shows that the years at any preschool tend to affect Japanese and mathematics equally, Model 4 (that includes years at nursery school and kindergarten separately) shows that years at kindergarten positively influence both Japanese and mathematics more significantly than years at nursery school. Model 5 suggests that only public nursery schools are worse than the other three types of preschools. Further, Model 6 shows that the correlation between being enrolled in kindergarten and achievement test is independent of the grade level at the time of this survey. Finally, Model 7 tries to uncover whether the correlation between kindergarten dummy and achievement measures is different across parent's income groups. However, both the low income dummy and its interaction with the kindergarten dummy are not significantly correlated with achievements.

Table 5 shows the results of the OLS estimates of total difficulty score and QOL total

based on the same set of specifications as Table 4. There are only two significant results to note here. First in Model 7, kindergarten attendance has favorable effect on total difficulty score for baseline children who are not from low income families. However, for children from low income families, kindergarten attendance marginally inceases the total difficulty. Second in Model 6, kindergarten attendance has marginally positive effect on QOL at grades 1- 3, but is like to lower QOL at grades 7 – 9.[14]

(Insert Table 5 here)

4.3 Results based on instrumental variable estimation

Next we present the estimation results based on the method of instrumental variables. We first attempted to apply IV estimation to the models 2, 3, 5, and 6 in the previous section, using the probability to attend kindergarten at municipality level as IV for the kindergarten attendance dummy supplemented with all the interactions with other dummy variabels when necessary. It turns out that all the models except for model 2 are found inappropriate because of weak instruments.[15] Therefore, we discuss only on the coefficient estimate of the kindergarten attendance dummy in model 1, namely the treatment effect of kindergarten attendance vs. nursery school.

[14] We did the same estimations in Tables 4 and 5 allowing clustering of errors at family level, but found little difference.
[15] To judge the weak instruments, we used the Kleibergen-Paap rk Wald statistic generated from ivreg2 command for Stata.

Table 6 shows the estimates of the treatment effect on the outcomes based under the two assumptions on the pattern of clustering: Model A allows clustering at individual level, and Model B allows clustering at family level. For each model, the coefficient estimates are shown for the four outcome measures: Japanese, math, total difficulty score, and QOL.

(Insert Table 6 here)

It is shown that none of the coefficients are statistically significant. F statistics for the weak instruments appear to be large enough to be able to ignore the concern of weak IVs. Since we have an additional IV, which is the local female employment rate, that allows us to test the overidentification restriction. The calculated Hansen's J statistics show that our IVs successfully pass the restriction and appears to be valid.

Overall, the OLS estimates provide evidence that kindergarten attendance is associated with slightly higher cognitive outcomes; however, statistically significant difference cannot be found under the instrumental variable estimation where all the conventional tests for the validity of instruments are passed. Therefore, the observed correlation between the kindergarten attendance and the higher test scores is unlikely to be causal. It is concluded that there is no evidence to suggest that kindergarten attendance increases test scores in Japanese and math.

It may be surprising if “educational” preschool can improve the cognitive ability of children no faster than “non-educational” preschools. There are three possible explanations. First it is possible that early childhood education that focus on cognitive development may not necessarily improve the child’s long-term cognitive outcomes (Heckman 2011). If it is true, perhaps education policy and institutions that focus more on non-cognitive ability may better improve educational outcomes of children. Second, although superficial names are different, kindergarten and nursery schools may in reality be equally efficient in improving the cognitive ability. This conjecture may be supported the national order which was issued in 1960s that required “the educational contents and curriculum at nursery schools should follow the national guideline for kindergarten.” It is possible that this remarkable government order issued 50 years ago has been so effective that there has been little differences in the education production process in the two types of preschools. Third, children who attend nursery school tend to be exposed to good educational environment for longer hours than children who attend kindergarten because nursery schools are full-time service and available from age 0. On the other hand, kindergarten is half-day program and starts only at 3 or 4 years old. Such a difference in the length of exposure may be a confounding factor. Therefore, the

result that the kindergarten attendance dummy has no effect does not necessarily mean that the two types of preschools have the same quality in education.

V. CONCLUSION

We have shown how children who went to kindergarten differ from children who went to nursery school, on several dimensions of cognitive and non-cognitive outcomes using data from children in Grades 1–9 collected in JCPS 2010–2014.

Based on OLS, it was found that children who went to kindergarten outperform children who went to nursery schools. Few non-cognitive outcome measures were found to correlate with the choice of preschools. The results of IV estimation, however, show that the differences found in OLS estimation may not mean a causal relationship. We provided alternative explanations why nursery schools can be as good as kindergarten in developing children's cognitive ability.

Future research should pursue estimating the effect of length of exposure to preschool programs on children's outcomes. Unfortunately, we have not found natural candidate of instrumental variables for the length of the program JCPS children attended. Future accumulation of panel data from all cohorts included in the data will enhance the availability of instrumental variables within a family, similar to Figlio and Roth (2009).

Finally, we need to estimate the effects of kindergarten on several subpopulations along alternative dimensions of family background, preferably with a larger data set. Estimation of the kindergarten effects on the subpopulation would enhance our knowledge of the heterogeneity of the preschool policy effects.

Appendix 1.

One-factor categorical factor analysis, which analyzes binary data, is expressed in the following formula:

$$z_{ij} = \alpha_j f_i + e_{ij}$$

In this case, α_j represents the factor pattern (factor loading) for item *j*. Next, f_i represents the common factor for participant *i*. Then, e_{ij} represents the error factor of item *j* for participant *i*. In normal factor analysis, z_{ij} represents the observed variable, but in categorical factor analysis, it represents the latent variable. When γ_j is deemed item *j*'s threshold, and the actual measured binary variable of 0 or 1 is deemed u_{ij}, it is observed that $u_{ij} = 1$ if $z_{ij} > \gamma_j$, and $u_{ij} = 0$ if $z_{ij} < \gamma_j$. The estimated parameter using the maximum likelihood method is the factor pattern α_j and threshold γ_j ($j = 1, \ldots, n$). Categorical factor analysis of binary data based on structural equation modeling is known to correspond to the two-parameter item response theory model (Hambleton and Swaminathan 1985).

In the present study, because the questions vary between school grades, estimates of factor pattern and threshold for each item concerning Japanese and mathematics were worked out for each school grade and for each item. Subsequently, the children's individual categorical factor scores for the two academic subjects were computed. We combined all the children's Japanese and mathematics categorical factor scores (from the 1st through 9th Grades) together respectively, and used them in the analysis as the individual child's academic ability (Japanese and mathematics) measures.

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Figure 1. Structure of JHPS, KHPS, and JCPS

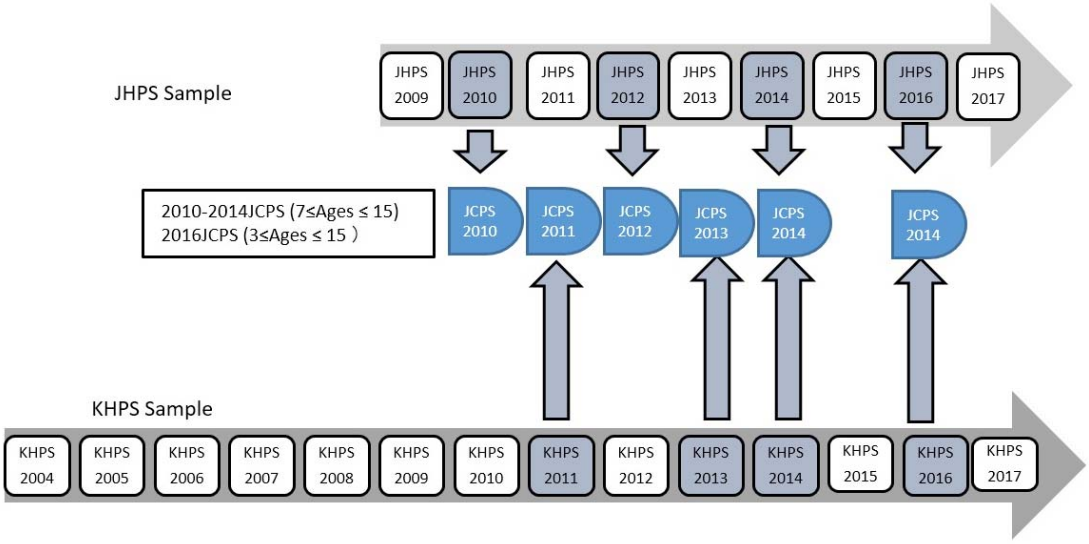

TABLE 1

Preschool enrollment rate in Japan by age of child (2011)

Enrollment	3 yr. old	4 yr. old	5 yr. old
Kindergarten	41.4%	53.6%	54.8%
Nursery school	37.2%	40.6%	39.8%
Total	78.6%	94.2%	94.4%

Source: MEXT (2013)

Note: Age of children is as of April 1.

TABLE 2

Households and children surveyed in JCPS

Survey year	Subject sample	Children's birth dates	Number of target households	Number of cooperative households	Response rate by household	Number of target children	Number of cooperative children	Response rate by child
2010	JHPS	1994/4/2 – 2003/4/1	644	312	48.4%	959	467	48.7%
2011	KHPS	1995/4/2 – 2004/4/1	730	434	59.5%	1126	662	58.8%
2012	JHPS	1996/4/2 – 2005/4/1	595	342	57.5%	888	493	55.5%
2013	KHPS	1997/4/2 – 2006/4/1	808	453	0.561	1242	709	57.1%
2014	JHPS/KHPS	1998/4/2 – 2007/4/1	1065	508	47.7	1600	752	47.0%

TABLE 3

Summary statistics by types of preschools and test results of mean equality

	Kindergarten		Nursery school		p-value	Test result
	N	Mean	N	Mean		
Preschool variables						
Private	1882	0.07	351	0.37	0.00	***
Years of attendance	1882	0.84	351	3.73	0.00	***
Grade group (base=1st-3rd grade)						
4th - 6th grade	1882	0.35	795	0.36	0.35	NS
7th - 9th grade	1882	0.33	795	0.26	0.00	***
Demographic and Family Background						
Father more than high school graduat	1882	0.46	795	0.47	0.85	NS
Mother more than high school graduat	1882	0.51	795	0.49	0.50	NS
Mother's age at birth	1882	30.24	795	29.87	0.05	*
One parent family	1882	0.02	795	0.05	0.00	***
Female child	1882	0.48	795	0.48	0.88	NS
Birth in 4th quarter	1882	0.23	795	0.24	0.51	NS
Number of siblings	1882	4.26	795	4.16	0.16	NS
Family income last year in mil Yen	1882	7.08	795	6.60	0.00	***
Low income family	1882	0.48	795	0.57	0.00	***
Cognitive tests						
Japanese	1882	0.09	795	-0.15	0.00	***
Math	1882	0.10	795	-0.18	0.00	***
SDQ total	1599	22.70	663	23.02	0.11	NS
QOL total (Grade 3-)	1257	90.17	501	89.60	0.42	NS

$\chi 2$ test is applied to dummy variables and two-sided t-test is applied to continuous variables.

* p<0.1 ** p<0.05 *** p<0.01

JCPS 2010-2014 except for SDQ and QOL indicators which are available only from 2011.

TABLE 4

Estimated effects of preschool types on cognitive outcomes (OLS)

Outcome	Japanese							Math						
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
kindergarten dummy	0.2373***	0.2110***	0.2571***			0.2191***	0.2203***	0.2804***	0.2465***	0.2836***			0.2230***	0.2733***
	(0.0535)	(0.0516)	(0.0543)			(0.0785)	(0.0689)	(0.0525)	(0.0512)	(0.0541)			(0.0771)	(0.0685)
years of schooling of preschool			0.0680***							0.0547***				
			(0.0197)							(0.0197)				
years of schooling of nursery school				0.0320*							0.0150			
				(0.0187)							(0.0187)			
years of schooling of kindergarten				0.0844***							0.0733**			
				(0.0295)							(0.0294)			
private nursery school dummy					0.2665***							0.2219**		
					(0.1016)							(0.0987)		
public kindergarten dummy					0.2067*							0.2308*		
					(0.1246)							(0.1254)		
private kindergarten dummy					0.2296***							0.2338***		
					(0.0732)							(0.0735)		
kindergarten x 4-6th grade dummy						0.0365							0.0618	
						(0.1016)							(0.1016)	
kindergarten x 7-9th grade dummy						−0.0752							0.0039	
						(0.1145)							(0.1142)	
low income family dummy							−0.2016**							−0.2192***
							(0.0823)							(0.0820)
low income family x kindergarten							−0.0240							−0.0525
							(0.0975)							(0.0968)
Observations	2677	2677	2677	2677	2677	2677	2677	2677	2677	2677	2677	2677	2677	2677
r2	0.0141	0.0755	0.0803	0.0700	0.0716	0.0759	0.0720	0.0184	0.0752	0.0784	0.0657	0.0677	0.0754	0.0723

Note:

* p<0.1 ** p<0.05 *** p<0.01

All the estimations are linear regression. Numbers in the parentheses are standard errors allowing clustering at individual level.

The controls are father is collge graduate, mother is more than high school education, one parent family, female child, number of siblings, mother's age at birth, grade, dummies for year of survey, 2nd income quartile, 3rd income quartile, 4th income quartile (the last three variables are omitted in model (7).

TABLE 5

Estimated effects of preschool types on non-cognitive outcomes

(total difficulty score and QOL score: OLS)

Model	Selected explanatory variables	total difficulty	QOL total
(1)			
	Kingergarten	−0.3339	0.5850
		(0.2424)	(0.8334)
(2)			
	Kingergarten	−0.2271	1.0223
		(0.2425)	(0.8120)
(3)			
	Kingergarten	−0.2634	1.2123
		(0.2559)	(0.8341)
	Years of any preschool	−0.0686	0.3311
		(0.0987)	(0.3558)
(4)			
	Yeas of nursery school	−0.0448	0.0943
		(0.0921)	(0.3670)
	Years of kindergarten	−0.0180	0.6771
		(0.1559)	(0.4984)
(5)			
	Private nursery schools	−0.4596	1.6256
		(0.5286)	(1.8226)
	Public kindergarten	−0.0857	2.0061
		(0.6540)	(1.9222)
	Private kindergarten	−0.1684	2.4651*
		(0.4045)	(1.3509)
(6)			
	Kingergarten	−0.3785	3.3107*
		(0.3781)	(1.9464)
	Kindergarten x Grade 4−6	0.2552	−1.2156
		(0.4818)	(2.1193)
	Kindergarten x Grade 7−9	0.2031	−4.7247**
		(0.5399)	(2.3219)
(7)			
	Kindergarten	−0.6633**	1.0008
		(0.3217)	(1.0471)
	Low−income family	0.5516	−1.8962
		(0.3905)	(1.3342)
	Kindergarten x low−income	0.8901*	−0.0000
		(0.4583)	(1.5345)
N		2262	1758

Note:

* p<0.1 ** p<0.05 *** p<0.01

All the estimations are linear regression. Numbers in the parentheses are robust standard errors clustered at individual level.

The controls are father is more than high school, mother is more than high school, one parent family, female child, number of siblings, mother's age at birth, grade, year of survey, 2nd income quartile, 3rd income quartile, 4th income quartile.

TABLE 6

IV (GMM) estimates of kindergarten attendance effect on

cognitive and non-cognitive outcomes of children

Model	Clustering	Statistics	Japanese	Math	total difficulty	total QOL
A	individual	Coefficient	−0.0067	−0.1720	−1.0523	3.0190
		(s.e.)	(0.1720)	(0.1727)	(0.7890)	(2.7578)
		N	1875	1875	1632	1212
		F statistics for Weak Instrument test	83.58	83.58	75.01	59.48
		Overidentification test (Hansen's J)	0.52	0.15	1.00	0.49
		p-value for Hansen's J	0.47	0.70	0.32	0.48
		Test statistics of exogeneity (C statistics)	1.59	6.27	0.67	0.34
		p-value for C statistics	0.21	0.01	0.41	0.56
B	Family	Coefficient	−0.0062	−0.1696	−1.0267	2.8930
		(s.e.)	(0.1991)	(0.1989)	(0.8671)	(2.9574)
		N	1875	1875	1632	1212
		F statistics for Weak Instrument test	55.80	55.80	50.83	41.79
		Overidentification test (Hansen's J)	0.43	0.11	0.76	0.43
		p-value for Hansen's J	0.51	0.74	0.38	0.51
		Test statistics of exogeneity (C statistics)	1.24	4.82	0.50	0.24
		p-value for C statistics	0.27	0.03	0.48	0.63

All the estimations are linear regression. Numbers in the parentheses are standard errors allowing clustering.
The controls are father is collge graduate, mother is more than high school education, one parent family, female child, number of siblings, mother's age at birth, grade, dummies for year of survey, 2nd income quartile, 3rd income quartile, 4th income quartile.